Chevron U.S.A. Inc.
C-147 Registration Application Package
Cotton Draw T25S R32E

- Section 9 Recycling Containment

February 28, 2023

Chevron U.S.A. Inc. | Cotton Draw T25S R32E Recycling Containment

Contents

I. INTRODUCTION

Chevron U.S.A. Inc. (Chevron) requests registration under 19.15.34 NMAC of the following recycling containment in the Cotton Draw development area located in Township 25 South, Range 32 East in southeastern Lea County.

- Section 9 Recycling Containment

Appendix 1 contains a survey plat identifying the location of the recycling containment. Note that the Section 9 recycling containment is identified as "Proposed Frac Pond", which has been constructed and currently contains non-recycled water, respectively on the plat.

Compliance with the requirements of 19.15.34.11 through 19.15.34.15 is described in this application. Note that Chevron is requesting a total of three variances from these requirements as noted in Section IV and fully described in Section VIII.

A copy of Form C-147 found in Section II has been submitted to the Bureau of Land Management, which is the surface landowner, as required under 19.15.34.10.A.

II. NMOCD FORM C-147

District I
1625 N. French Dr., Hobbs, NM 88240
District II
811 S. First St., Artesia, NM 88210
District III
1000 Rio Brazos Road, Aztec, NM 87410
District IV
1220 S. St. Francis Dr., Santa Fe, NM 87505

State of New Mexico
Energy Minerals and Natural Resources
Department
Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, NM 87505

Form C-147
Revised April 3, 2017

Recycling Facility and/or Recycling Containment

Type of Facility: ☐ Recycling Facility ☒ Recycling Containment*

Type of action: ☐ Permit ☒ Registration ☐ Modification ☐ Extension ☐ Closure ☐ Other (explain) _____

*** At the time C-147 is submitted to the division for a Recycling Containment, a copy shall be provided to the surface owner.**

Be advised that approval of this request does not relieve the operator of liability should operations result in pollution of surface water, ground water or the environment. Nor does approval relieve the operator of its responsibility to comply with any other applicable governmental authority's rules, regulations or ordinances.

1.

Operator: Chevron U.S.A. Inc. (For multiple operators attach page with information) OGRID #: 4323

Address: 1400 Smith Street, Houston, TX 77002

Facility or well name (include API# if associated with a well): Cotton Draw Section 9 Recycling Containment

OCD Permit Number: _____ (For new facilities the permit number will be assigned by the district office)

U/L or Qtr/Qtr A/B Section 9 Township 25 Range 32 County: Lea

Surface Owner: ☒ Federal ☐ State ☐ Private ☐ Tribal Trust or Indian Allotment

2.

☐ **Recycling Facility:**

Location of recycling facility (if applicable): Latitude _____ Longitude _____ NAD83

Proposed Use: ☐ Drilling* ☐ Completion* ☐ Production* ☐ Plugging *

The re-use of produced water may NOT be used until fresh water zones are cased and cemented

☐ Other, ***requires permit for other uses. Describe use, process, testing, volume of produced water and ensure there will be no adverse impact on groundwater or surface water.***

☐ Fluid Storage

☐ Above ground tanks ☐ Recycling containment ☐ Activity permitted under 19.15.17 NMAC explain type_____

☐ Activity permitted under 19.15.36 NMAC explain type:_____ ☐ Other explain _____

☐ For multiple or additional recycling containments, attach design and location information of each containment

☐ **Closure Report (required within 60 days of closure completion):** ☐ Recycling Facility Closure Completion Date:_____

3.

☒ **Recycling Containment:** (Location: U/L: A/B, Section: 9, T25S, R32E)

☐ Annual Extension after initial 5 years (attach summary of monthly leak detection inspections for previous year)

Center of Recycling Containment (if applicable): Latitude 32.15080 Longitude -103.67564 NAD83

☐ For multiple or additional recycling containments, attach design and location information of each containment

☒ Lined ☒ Liner type: Thickness 60 mil ☐ LLDPE ☒ HDPE ☐ PVC ☐ Other _____

☐ String-Reinforced

Liner Seams: ☒ Welded ☐ Factory ☐ Other Field Volume: 699,947 bbl Dimensions: L 1,500 x W 750 x D 15

☐ Recycling Containment Closure Completion Date:_____

4.

Bonding:

☒ Covered under bonding pursuant to 19.15.8 NMAC per 19.15.34.15(A)(2) NMAC **(These containments are limited to only the wells owned or operated by the owners of the containment.)**

☐ Bonding in accordance with 19.15.34.15(A)(1). Amount of bond $_____ **(work on these facilities cannot commence until bonding amounts are approved)**

☐ Attach closure cost estimate and documentation on how the closure cost was calculated.

5.

Fencing:

☐ Four foot height, four strands of barbed wire evenly spaced between one and four feet

☒ Alternate. Please specify Eight-foot-tall chain link fence with three strands of barbed wire. Please see attached (Sec. VIII.B) regarding fencing for details.

6.

Signs:

☒ 12"x 24", 2" lettering, providing Operator's name, site location, and emergency telephone numbers

☐ Signed in compliance with 19.15.16.8 NMAC

7.

Variances:

Justifications and/or demonstrations that the proposed variance will afford reasonable protection against contamination of fresh water, human health, and the environment.

Check the below box only if a variance is requested:

☒ Variance(s): Requests must be submitted to the appropriate division district for consideration of approval. If a Variance is requested, include the variance information on a separate page and attach it to the C-147 as part of the application.

If a Variance is requested, it must be approved prior to implementation.

8.

Siting Criteria for Recycling Containment

Instructions: The applicant must provide attachments that demonstrate compliance for each siting criteria below as part of the application. Potential examples of the siting attachment source material are provided below under each criteria.

General siting

Ground water is less than 50 feet below the bottom of the Recycling Containment. NM Office of the State Engineer - iWATERS database search; USGS; Data obtained from nearby wells	☐ Yes ☒ No ☐ NA
Within incorporated municipal boundaries or within a defined municipal fresh water well field covered under a municipal ordinance adopted pursuant to NMSA 1978, Section 3-27-3, as amended. - Written confirmation or verification from the municipality; written approval obtained from the municipality	☐ Yes ☒ No ☐ NA
Within the area overlying a subsurface mine. - Written confirmation or verification or map from the NM EMNRD-Mining and Minerals Division	☐ Yes ☒ No
Within an unstable area. - Engineering measures incorporated into the design; NM Bureau of Geology & Mineral Resources; USGS; NM Geological Society; topographic map	☐ Yes ☒ No
Within a 100-year floodplain. FEMA map	☐ Yes ☒ No
Within 300 feet of a continuously flowing watercourse, or 200 feet of any other significant watercourse, or lakebed, sinkhole, or playa lake (measured from the ordinary high-water mark). - Topographic map; visual inspection (certification) of the proposed site	☐ Yes ☒ No
Within 1000 feet from a permanent residence, school, hospital, institution, or church in existence at the time of initial application. - Visual inspection (certification) of the proposed site; aerial photo; satellite image	☐ Yes ☒ No
Within 500 horizontal feet of a spring or a fresh water well used for domestic or stock watering purposes, in existence at the time of initial application. - NM Office of the State Engineer - iWATERS database search; visual inspection (certification) of the proposed site	☐ Yes ☒ No
Within 500 feet of a wetland. - US Fish and Wildlife Wetland Identification map; topographic map; visual inspection (certification) of the proposed site	☐ Yes ☒ No

9.
Recycling Facility and/or Containment Checklist:
Instructions: Each of the following items must be attached to the application. Indicate, by a check mark in the box, that the documents are attached.

- ☒ Design Plan - based upon the appropriate requirements.
- ☒ Operating and Maintenance Plan - based upon the appropriate requirements.
- ☒ Closure Plan - based upon the appropriate requirements.
- ☒ Site Specific Groundwater Data -
- ☒ Siting Criteria Compliance Demonstrations –
- ☒ **Certify that notice of the C-147 (only) has been sent to the surface owner(s)**

10.
Operator Application Certification:
I hereby certify that the information and attachments submitted with this application are true, accurate and complete to the best of my knowledge and belief.

Name (Print): Tony Vallejo Title: Sr. Workforce Safety & Environmental Specialist - Factory

Signature: Tony Vallejo Date: 2/28/2023

e-mail address: jvallejo@chevron.com Telephone: O: 432-687-7524 or C: 325-450-1413

11.
OCD Representative Signature: Victoria Venegas **Approval Date:** 03/14/2023

Title: Environmental Specialist **OCD Permit Number:** 1RF-503

☒ OCD Conditions

☒ Additional OCD Conditions on Attachment

III. SITING REQUIREMENTS

A. DISTANCE TO GROUNDWATER

Appendix 2 / Figure 1 and 4, Appendix 3, and the discussion below demonstrates that depth to groundwater at the proposed location is greater than 50 feet beneath the bottom of the recycling containment. Appendix 2 / Figure 1 is a geologic map based on a GIS database of geologic units and structural features in the general location.

In the survey area, the Rustler Formation, Dockum Group and the Alluvium / Ogallala have the potential to provide small quantities of water to water supply wells. However, no water wells were found in the survey area, whether during the field survey or through a search of the New Mexico OSE water database (Appendix 2, Figure 4). Several water wells have been identified in the general vicinity of the survey area (within 2 to 5 miles) which are used primarily to support domestic, livestock and/or oil and gas exploration and development water needs. The depths of the wells indicate that some are completed in the alluvium, some in the Dockup, and one may be completed in the lower part of the Triassic Dockum or the Rustler Formation. Depth to water range from 110 feet to 405 feet for the alluvium and Dockum wells. No water level data was found for the Dockum/Rustler well in the OSE database.

Between March 12th and 14th, 2018, Tetra Tech and our drilling subcontractor drilled five (5) exploratory soil borings to identify subsurface conditions and collect samples. Borings were drilled to depths ranging from 40 feet to 80 feet below the existing ground surface (bgs). Water was not encountered in the borings during or immediately after drilling. The boreholes were backfilled with the excavated soils following competition of drilling. Approximate locations of the borings are shown in Appendix 3.

B. DISTANCE TO SURFACE WATER

Appendix 2 / Figure 2 illustrates that the recycling containment is not located within 300 feet of a continuously flowing watercourse or 200 feet of any other significant watercourse, lakebed, sinkhole, or playa lake (measured from the ordinary high-water mark).

No continuously flowing watercourses of other significant water features, as defined by NMOCD rules, are located with the prescribed setbacks. Appendix 2 / Figure 2 identifies the nearest watercourses approximately 15,203 feet south of the recycling containment.

C. DISTANCE TO PERMANENT RESIDENCE OR INSTITUTIONS

Appendix 2 / Figure 3 illustrates that the recycling containment is not located within 1,000 feet of a permanent residence, school, hospital, institution, or church in existence at the time of this initial registration. The only development and structures in the prescribed setback area is associated with oil and gas production operations.

D. DISTANCE TO DOMESTIC AND STOCK WATER SUPPLIES

Appendix 2 / Figure 4 illustrates that the recycling containment is not located within 500 feet of a spring or fresh water well used for domestic of stock watering purposes at the time of this initial registration.

Appendix 2 / Figure 4 identifies that the nearest water well listed in the NMOSE database is located approximately 18,968 feet west of the recycling containment.

E. DISTANCE TO MUNICIPAL BOUNDARIES AND FRESH WATER FIELDS

Appendix 2 / Figure 5 illustrates that the recycling containment is not within incorporated municipal boundaries or within defined municipal fresh water well fields covered under a municipal ordinance adopted pursuant to Section 3-27-3 NMSA 1978, as amended.

The nearest municipal community to the recycling containment is:

- Village of Loving, which is incorporated, but does not operate any municipal fresh water well fields, located approximately 27 miles west; and
- Village of Malaga, which is not incorporated, located approximately 24 miles west.
- The City of Jal, which is incorporated, is located approximately 28 miles east and operates the Jal Well Field located southwest of the city.

F. DISTANCE TO WETLANDS

Appendix 2 / Figure 3 illustrates that the recycling containment is not located within 500 feet of any identified wetland. The nearest identified wetland is approximately 17,762 feet east of the recycling containment.

G. DISTANCE TO SUBSURFACE MINES

General knowledge based on interaction with the Bureau of Land Management (BLM) Carlsbad Field Office (CFO) staff and a search of the NM EMNRD Mining and Minerals Division database confirms that there are no subsurface mines in proximity of the recycling containment (Appendix 2 / Figure 6). The only identified facilities in the general vicinity are surface caliche and aggregate pits.

H. DISTANCE TO CAVE / KARST FEATURES

The recycling containment is located within a BLM-identified low potential karst zone. Appendix 2 / Figure 7, BLM inventory data of existing cave/karst features, and results of site-specific geotechnical studies as detailed in Appendix 3, verify that the recycling containment is not located within an unstable area.

I. DISTANCE TO 100-YEAR FLOODPLAINS

Appendix 2 / Figure 8 illustrates that the recycling containment location is within the FEMA-identified Zone D, which is an area with possible, but undetermined flood hazards where flood hazard analysis has not been conducted, mapped, and generally considered to be of minimal flood risk.

IV. DESIGN AND CONSTRUCTION PLAN

Appendix 4 contains the design drawings and details for the recycling containment, which were developed and stamped by a Professional Engineer licensed in the state of New Mexico. Appendix 5 contains the construction specifications to accompany the design drawings and details. These design and construction specifications meet or exceed NMOCD requirements for recycling containments. Appendix 6 contains the Geotechnical Engineering Study Report for the recycling containment site.

A. GENERAL SPECIFICATIONS

The following general specifications have been incorporated into the design and will be met during construction.

- The recycling containment is designed and will be constructed to ensure confinement of produced water, to prevent releases, and to prevent overtopping due to wave action or rainfall.
- The recycling containment, as designed, will be constructed with a proper foundation and interior slopes consisting of a firm, unyielding base, which is smooth and free of rocks, debris, sharp objects, and irregularities. In addition, 8 ounce non-woven geotextile will be installed under the secondary liner to provide additional protection from any protuberances in the foundation and reduction of localized stress-strain.
- The recycling containment will be constructed in a levee with inside and outside grades of three horizontal feet to one vertical foot (3H:1V), which is shallower and provides greater stability than the NMOCD 2H:1V specification for the inside grade.
- The recycling containment will be constructed with a 60 mil HDPE primary and secondary liner and an interstitial leak detection system. Note that the 60 mil HDPE secondary liner exhibits a hydraulic conductivity of less than 1 x 10^{-12} cm/sec. **Note that this is a variance** from the specified 30 mil LLDPE string reinforced liner or equivalent with a hydraulic conductivity of 1 x 10^{-9} cm/sec and provides greater protection of fresh water, public health, and the environment. Please refer to Section VIII.A that provides a full description and basis for this variance request.
- The exterior edges of both liners will be anchored in the bottom of a 24-inch deep compacted earth-filled trench, which exceeds the NMOCD 18 inch specification.
- Liner seams will be minimized and oriented vertically rather than across all levee slopes. Factory welded seams will be utilized to the maximum extent possible. Sloped liner panels will extend a minimum of five feet beyond the point of grade change to prevent seams from resting on the grade break.
- All field seams and welds will be subjected to non-destructive field testing by qualified personnel per the appropriate testing standard to ensure proper thermal sealing. Details on liner testing procedures may be found in Section 33 47 13 / Subpart 3.04 of the construction specification (Appendix 5). Field seams will be overlapped a minimum of six inches.

- The primary liner will be protected from excessive hydraulic force or mechanical damage from discharge or suction within the recycling containment. No discharge or suction lines penetrate the liners.
- The recycling containment will be constructed with a leak detection system between the primary and secondary liners comprised of a 200-mil geonet. The system is properly designed to facilitate effective drainage, collection, and removal of liquid above the secondary liner and leakage detection at the earliest possible time.
- The recycling containment is designed to prevent run-on of surface water. The minimal distance from the existing surface elevation to the top of the containment berm will be approximately four feet.

B. STOCKPILING OF TOPSOIL

Where topsoil is present, prior to constructing the recycling containment, it will be stripped and stockpiled on site for use as final cover or fill at time of closure.

C. SIGNS

An upright sign no less than 12 inches by 24 inches with lettering no less than two inches in height will be installed in a conspicuous place on the fence surrounding the containment. The sign will be installed in such a manner and location that a person can easily read the legend. The sign will include the following information:

- The operator's name;
- The location of the site by quarter-quarter or unit letter, section, township, and range;
- Emergency telephone number.

D. FENCING

The recycling containment will be constructed with an eight-foot-tall chain link fence equipped with three strands of barbed wire on top to deter unauthorized wildlife and human access. **Note that this is a variance** from the minimum required four-foot fence with at least four stands of barbed wire evenly spaced in the intervals between one foot and four feet above ground level and provides equivalent or greater wildlife and human deterrence. Please refer to Section VIII.B that provides a full description and basis for this variance request.

The fence will be gated to provide access to Operations personnel and will be closed and locked when access is not required.

E. NETTING AND WILDLIFE PROTECTION

The game fence, as described above, surrounding the recycling containment will be effective in excluding terrestrial wildlife. Due to infeasibility of installing netting on a recycling containment system of this size (1,500 feet by 750 feet), an audible avian deterrence system has been designed and will be installed as an alternative. This type of system has been utilized by other recycling containment

operators in southeast New Mexico and has been demonstrated as providing effective protection for avian species, including migratory birds. **Note that this is a variance** from the specified screening or netting and will provide equal protection of avian species. Please refer to Section VIII.C that provides a full description and basis for this variance request.

Containment inspections will be conducted at least once per week to include visual determination of any wildlife impacts. If any dead migratory birds or other wildlife is detected, notification to the New Mexico Department of Game and Fish and NMOCD District Office will provided as soon as practicable but no later than 30 days from the date of discovery.

V. OPERATING AND MAINTENANCE PLAN

The recycling containment will be operated in such a manner to contain liquids and solids and the integrity of the liner and leak detection system will be monitored in such a manner to prevent contamination of fresh water and protect public health and the environment as described below. The purpose of the recycling containment is to facilitate recycling of treated produced water from nearby oil and gas wells for new well completions. When treated produced water is not needed for well completion activity, produced water will be properly injected at one of Chevron's or third party's authorized SWDs. The recycling containment will not be used for disposal of produced water or other oilfield wastes.

The recycling containment and associated leak detection system will be inspected at least weekly while it contains any fluid and results of the inspection will be documented on an inspection checklist. These inspections will be performed by a third party contractor, which has been selected by Chevron to operate the recycling facilities and monitor the associated recycling containments. The contractor will continuously staff these facilities while in operation. The completed checklists will be retained and made available for review upon request.

These inspections will address, at a minimum, the following:

- Removal of any visible layer of oil from the liquid surface;
- Verification that a minimum of three-foot freeboard is maintained;
- If a liner breach is identified above the liquid surface, the liner will be repaired or liner replacement will be initiated within 48 hours of detection. Alternatively, the NMOCD district office will be contacted within 48 hours to seek and extension for liner repair / replacement.
- If a liner breach is identified below the liquid surface, all liquid above the identified breach will be removed, the NMOCD district office will be notified, and liner repair / replacement shall be initiated within 48 hours of discovery.
- Visual inspection of berm integrity and condition to ensure the prevention of surface water run-on.

- Determination that an oil absorbent boom is present and in proper condition to contain an unanticipated release.

The recycling containment will be equipped with continuous liquid level monitoring and interstitial leak detection systems utilizing pressure transducers connected through a SCADA system to provide immediate notification to Chevron field personnel.

Treated produced water deposits into and withdrawals from the recycling containment will be measured and documented to determine when the system has ceased operations (less than 20% of the total fluid capacity is used during each rolling six-month period following the initial withdrawal of produced water). The third-party contactor will keep accurate records of total volumes of water received and treated through the recycling facility. Chevron will submit Form C-148 monthly to NMOCD within 30 days of the end of the calendar month listing: volumes of produced water received; volumes of fresh or brackish water received; and total volume of water leaving the recycling facility.

Upon cessation of operation, the NMOCD district office will be notified. Chevron will submit to NMOCD a completed Form C-148 within 30 days following the end of each calendar month. Each submittal will certify that the recycling containment has not ceased operation based on the 20% threshold described above.

VI. CLOSURE PLAN

After operations cease (less than 20% of the total fluid capacity is used every six-months following the initial withdrawal of produced water), all fluids will be removed within 60 days and the recycling containment closed within six-months.

All removed liquids, solids, and liner materials will be removed and transferred to an NMOCD-approved disposal facility within the six-month period.

A five-point composite sample will be collected from beneath the containment and tested for contamination. The composite sample will include stained or wet soil areas, if any, and analyzed for constituents listed in Table I of 19.15.34.14 NMAC.

- If any contaminant concentration exceeds the values listed in Table I (based on depth from bottom of containment to groundwater), the NMOCD district office will be contacted requesting approval before proceeding with closure activity.
- If all contaminant concentrations are less than or equal to the values listed in Table I, closure will proceed by backfilling with non-waste containing, uncontaminated, earthen material.

Within 60 days of completing closure, a Closure Report on NMOCD Form C-147, including required attachments, will be submitted to document all closure activities including sampling results and details of any backfilling, capping, or covering, were applicable. The Closure Report will certify that all

information in the report and attachments is correct and that all applicable closure requirements and conditions specified in NMOCD rules and directives have been met.

The recycling containment's locations will be reclaimed to a safe and stable condition that blends with the surrounding undisturbed areas. Topsoils and subsoils will be replaced to their original relative positions and contoured to achieve erosion control, long-term stability, and preservation of surface water flow patterns.

The location will be reseeded in the first favorable growing season following closure with the goal of substantially restoring the impact surface location to the existing condition prior to construction of the recycling containment. Surface reclamation will be deemed complete when: all ground surface disturbing activities have been completed; a uniform vegetative cover with a life-form ratio of plus or minus 50% of pre-disturbance levels has been established; and a total percent plant over of at least 70%, excluding noxious weeds, has been established.

Surface reclamation obligations imposed by the Bureau of Land Management or New Mexico State Trust Land on lands managed by those agencies will supersede these requirements, provided that these other requirements provide equal or greater protection of fresh water, human health, and the environment.

NMOCD will be notified when reclamation and re-vegetation are complete.

VII. FINANCIAL ASSURANCE REQUIREMENTS

Chevron U.S.A. Inc. (OGRID 4323) has existing financial assurance in place with NMOCD as required by 19.15.8 NMAC and use of the recycling containment will be limited to support completion of only wells owned and operated by Chevron U.S.A. Inc. Therefore, no additional financial assurance associated with the recycling containment is required.

VIII. VARIANCE REQUESTS

This registration includes requests for three variances from the requirements for each recycling containment as described below.

A. SECONDARY LINER SPECIFICATION

The recycling containment has been designed and will be constructed with a 60 mil HDPE secondary liner rather than the prescribed 30 mil LLDPE secondary liner. Chevron has selected the 60 mil HPDE material for the following reasons:

- The 60 mil HDPE exhibits a maximum hydraulic conductivity of 1×10^{-12} cm/sec, which exceeds the specified performance of 1×10^{-9} cm/sec.

- The US Environmental Protection Agency identifies 60 mil as the recommended minimum thickness for HDPE as detailed in the EPA's Guide for Industrial Waste Management, Part IV, Chapter 7, Section B, page 7B-24 addressing protection of groundwater through proper design and installation of double liner systems.
- HDPE was selected as the preferred secondary liner material based upon weathering/aging characteristics, mechanical properties, and chemical resistance.
- HDPE liner life is expected to exceed twenty years, which is substantially longer than the anticipated age of the recycling containment to support well completion activities in the development area.
- The 60 mil HDPE liner is compliant with internal Chevron Global engineering design and environmental performance standards.

Chevron believes that this variance from the NMOCD prescribed liner specification is warranted and provides greater protection of groundwater resources. Liner hydraulic conductivity and performance specifications are found in Appendix 6.

B. FENCING

The recycling containment has been designed and will be equipped with an eight-foot-tall chain link fence equipped with three strands of barbed wire on top. This fence will not be installed with the specified four stands of barbed wire but offers equivalent entry deterrence to wildlife and unauthorized human without introducing the risk of injury resulting from unintended or incidental contact with the barbed wire.

C. NETTING

The recycling containment has been designed and will be equipped with an audible avian species protection system, which effectively deters birds from approaching the area. Due to the size of the proposed recycling containment structure (1,500 feet by 750 feet), design, construction, and maintenance of netting is not practicable. Chevron has evaluated multiple alternatives, determined that an audible system is the most effective and viable option, and selected the Bird-X Mega Blaster PRO for use. This particular product has been used by other operators with registered recycling containments in southeast New Mexico and proven effective.

IX. APPENDICES

Appendix 1 – Survey Plat

R 32 E

Sec. 4
Bureau of Land Management

Sec. 3
Bureau of Land Management

Fnd. 2" Iron Pipe w/ Cap @ the NW Corner of Section 10

T 25 S

Sec. 9
Bureau of Land Management

Sec. 10
Bureau of Land Management

PROPOSED FRAC POND AREA
±25.83 Acres

700' 700'

2 3 4 5

100'

750'

FRAC POND 1

FRAC POND 2

1500'

S 46° 21' 37" W 2,404.15'

Existing Pipeline

Existing Pipeline

Existing Power Line & Existing Fence

Orla Road

Existing P&A'd Well

CENTERLINE PROPOSED ACCESS ROAD
30'x ±709.12'
±42.98 Rods
±0.49 Acres

1

PROPOSED 60' WIDE ROW
±3,283.22',
±198.98 Rods

Proposed Bobcat Pad Access

Proposed 60' Wide ROW

LEGEND

- Proposed Pond
- CL Proposed Access Road
- Proposed ROW
- Proposed Access
- Section Line
- Existing Power Line
- Existing Fence
- Existing Road
- Existing Pipeline
- Power Pole
- P&A'd Well
- Fnd. Monument

NAD 27 NEW MEXICO EAST ZONE

Scale: 1" = 400'

400' 0 200' 400'

FOR THE EXCLUSIVE USE OF CHEVRON U.S.A. INC.
I, Robert L. Lastrapes, Professional Surveyor, do hereby state this plat is true and correct to the best of my knowledge.

ROBERT L. LASTRAPES NEW MEXICO 23006 PROFESSIONAL SURVEYOR

4-4-2018

Robert L. Lastrapes
Registration No. 23006

FENSTERMAKER
C. H. Fenstermaker & Associates, L.L.C.
135 Regency Sq. Lafayette, LA 70508
Ph. 337-237-2200 Fax. 337-232-3299
www.fenstermaker.com

SURFACE USE PLAT

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CHEVRON U.S.A. INC.

PROPOSED FRAC POND & ACCESS ROAD
COTTON DRAW FACILITIES
SECTION 9, T25S-R32E
LEA COUNTY, NEW MEXICO

	REVISIONS			
DRAWN BY: DMB	#	BY:	DATE:	DESCRIPTION:
PROJ. MGR.: VHV	1	VHV	03/07/2018	Added south access & ROW.
DATE: 02/06/2018	2	VHV	03/29/2018	Removed north access road. Extended ROW.
FILENAME: T:\2018\2187194\DWG\Cotton Draw Frac Pond_Sec 9_SUP.dwg				

DISCLAIMER: At this time, C. H. Fenstermaker & Associates, L.L.C. has not performed nor was asked to perform any type of engineering, hydrological modeling, flood plain, or "No Rise" certification analyses, including but not limited to determining whether the project will impact flood hazards in connection with federal/FEMA, state, and/or local laws, ordinances and regulations. Accordingly, Fenstermaker makes no warranty or representation of any kind as to the foregoing issues, and persons or entities using this information shall do so at their own risk.

NOTE:
Please be advised, that while reasonable efforts are made to locate and verify pipelines and anomalies using our standard pipeline locating equipment, it is impossible to be 100 % effective. As such, we advise using caution when performing work as there is a possibility that pipelines and other hazards, such as fiber optic cables, PVC pipelines, etc. may exist undetected on site.

NOTE:
Many states maintain information centers that establish links between those who dig (excavators) and those who own and operate underground facilities (operators). It is advisable and in most states, law, for the contractor to contact the center for assistance in locating and marking underground utilities. For guidance, New Mexico One Call www.nmonecall.org

CENTERLINE PROPOSED ACCESS ROAD		
COURSE	BEARING	DISTANCE
1	SOUTH	709.12'

PROPOSED FRAC POND AREA		
COURSE	BEARING	DISTANCE
2	EAST	1500.00'
3	SOUTH	750.00'
4	WEST	1500.00'
5	NORTH	750.00'

NW FRAC POND CORNER		NE FRAC POND CORNER	
X=	702,921 NAD 27	X=	704,421 NAD 27
Y=	419,490	Y=	419,490
LAT.	32.151596	LAT.	32.151570
LONG.	103.677664	LONG.	103.672818
X=	744,106 NAD83	X=	745,606 NAD83
Y=	419,548	Y=	419,548
LAT.	32.151720	LAT.	32.151695
LONG.	103.678141	LONG.	103.673294
ELEVATION +3463' NAVD 88		ELEVATION +3467' NAVD 88	
SW FRAC POND CORNER		SE FRAC POND CORNER	
X=	702,921 NAD 27	X=	704,421 NAD 27
Y=	418,740	Y=	418,740
LAT.	32.149534	LAT.	32.149509
LONG.	103.677679	LONG.	103.672832
X=	744,106 NAD83	X=	745,606 NAD83
Y=	418,798	Y=	418,798
LAT.	32.149658	LAT.	32.149633
LONG.	103.678156	LONG.	103.673309
ELEVATION +3458' NAVD 88		ELEVATION +3465' NAVD 88	

FOR THE EXCLUSIVE USE OF
CHEVRON U.S.A. INC.
I, Robert L. Lastrapes, Professional Surveyor, do hereby state this plat is true and correct to the best of my knowledge.

ROBERT L. LASTRAPES NEW MEXICO 23006 PROFESSIONAL SURVEYOR
4-4-2018

Robert L. Lastrapes
Registration No. 23006

FENSTERMAKER

C. H. Fenstermaker & Associates, L.L.C.
135 Regency Sq. Lafayette, LA 70508
Ph. 337-237-2200 Fax. 337-232-3299
www.fenstermaker.com

SURFACE USE PLAT

Page 2 of 2

CHEVRON U.S.A. INC.

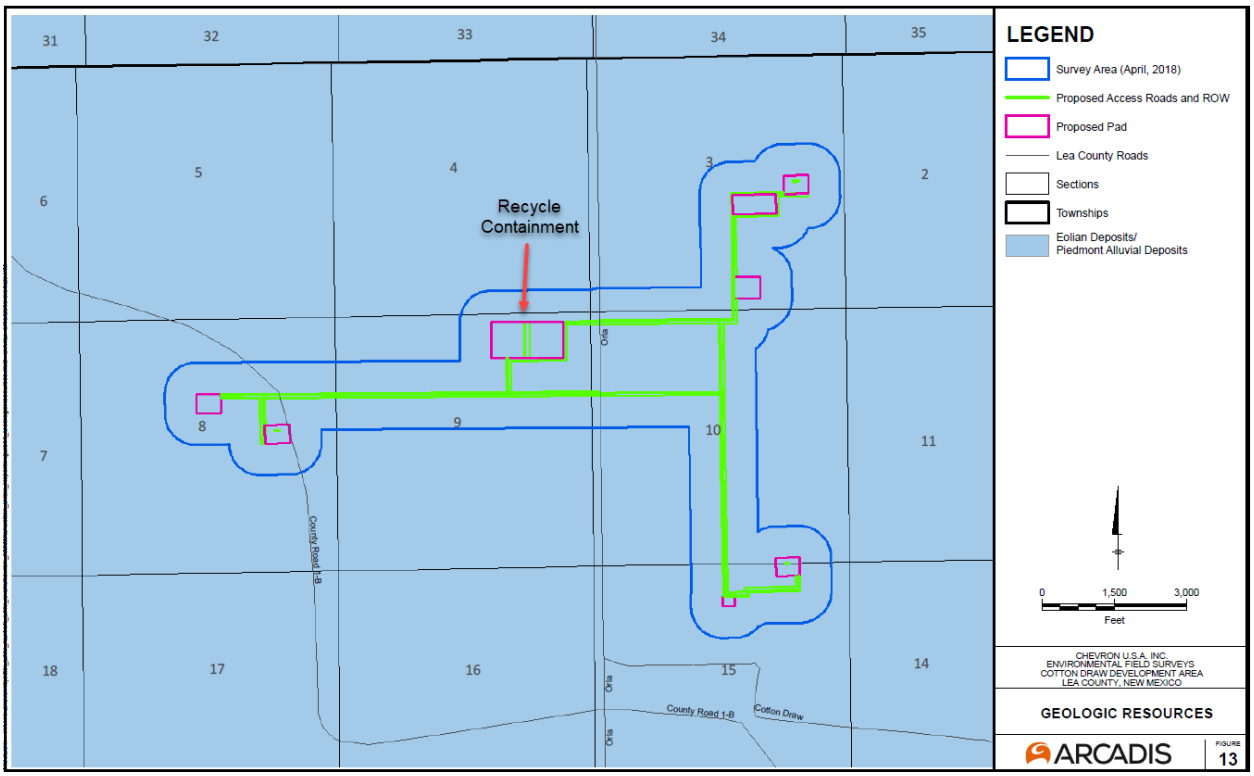
PROPOSED FRAC POND & ACCESS ROAD
COTTON DRAW FACILITIES
SECTION 9, T25S-R32E
LEA COUNTY, NEW MEXICO

	REVISIONS			
DRAWN BY: DMB	#	BY:	DATE:	DESCRIPTION:
PROJ. MGR.: VHV	1	VHV	03/07/2018	Added south access & ROW.
DATE: 02/06/2018	2	VHV	03/29/2018	Removed north access road. Extended ROW.
FILENAME: T:\2018\2187194\DWG\Cotton Draw Frac Pond_Sec 9_SUP.dwg				

Appendix 2 – Recycling Containment Figures

Chevron U.S.A. Inc. | Cotton Draw T25S R32E Recycling Containment

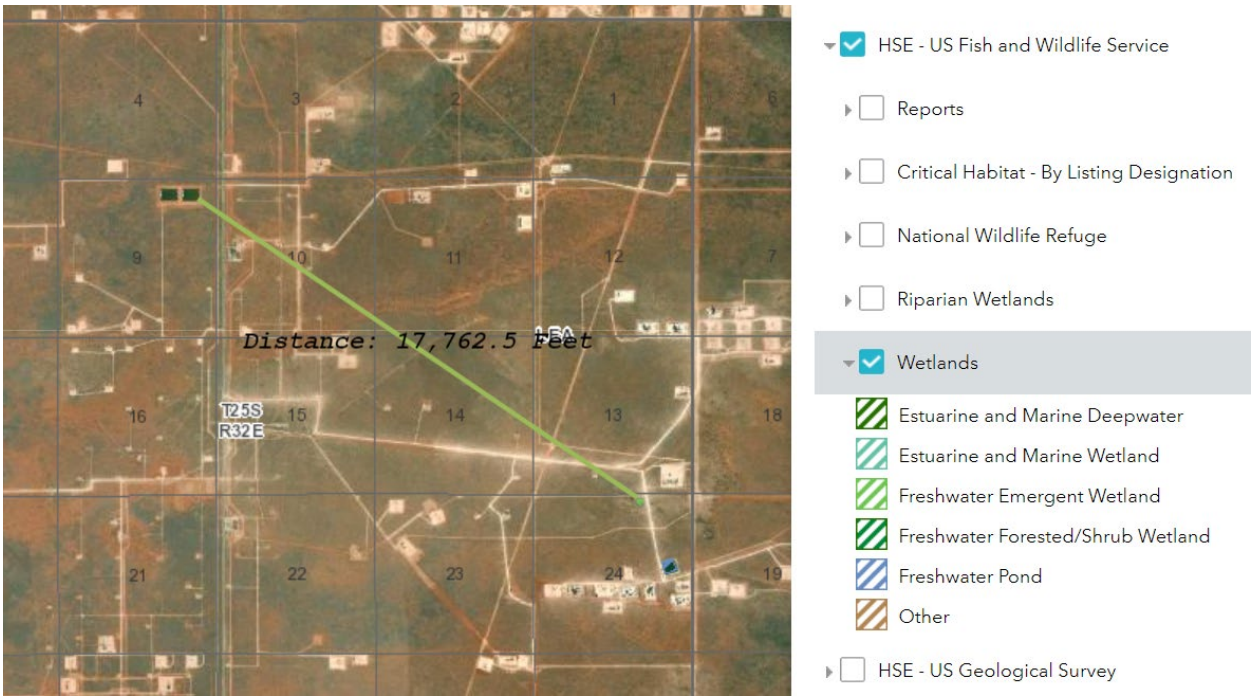
Chevron USA Inc. Cotton Draw T25S R32E Section 9 Recycle Containment/Appendix 2/Figure 1: Geologic Map



Chevron U.S.A. Inc. | Cotton Draw T25S R32E Recycling Containment

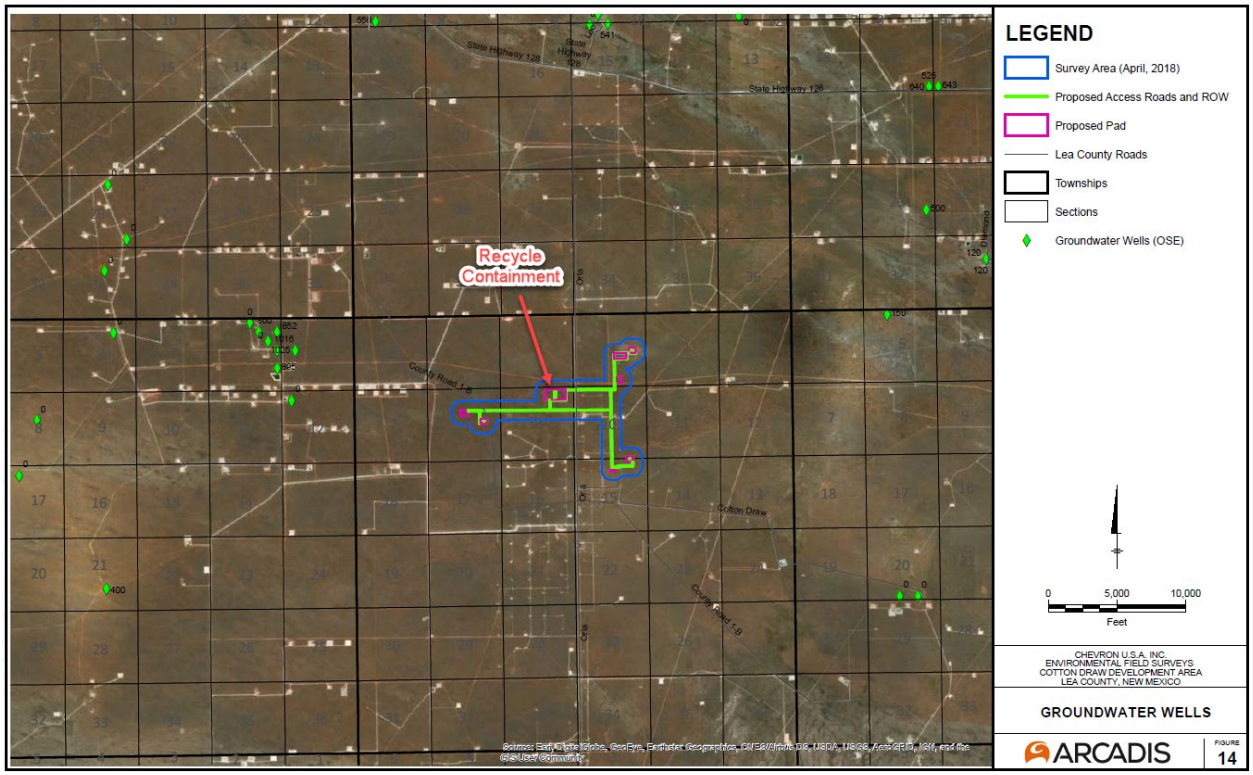
Chevron USA Inc. Cotton Draw T25S R32E Section 9 Recycle Containment/Appendix 2/Figure 2: Surface Water Features and Watercourses

Chevron USA Inc. Cotton Draw T25S R32E Section 9 Recycle Containment/Appendix 2/Figure 3: Permanent Residences and Institutions, Wetlands



Chevron U.S.A. Inc. | Cotton Draw T25S R32E Recycling Containment

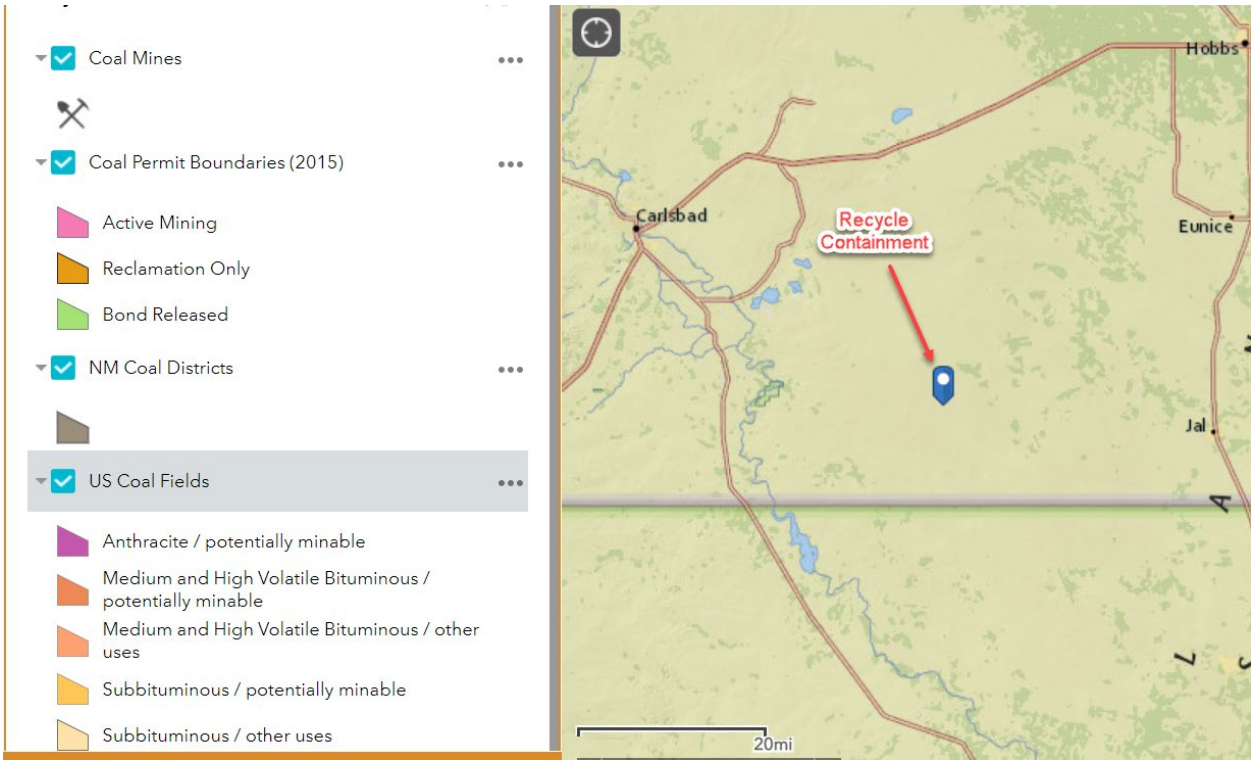
Chevron USA Inc. Cotton Draw T25S R32E Section 9 Recycle Containment/Appendix 2/Figure 4: Domestic and Stock Water Supplies



Chevron U.S.A. Inc. | Cotton Draw T25S R32E Recycling Containment

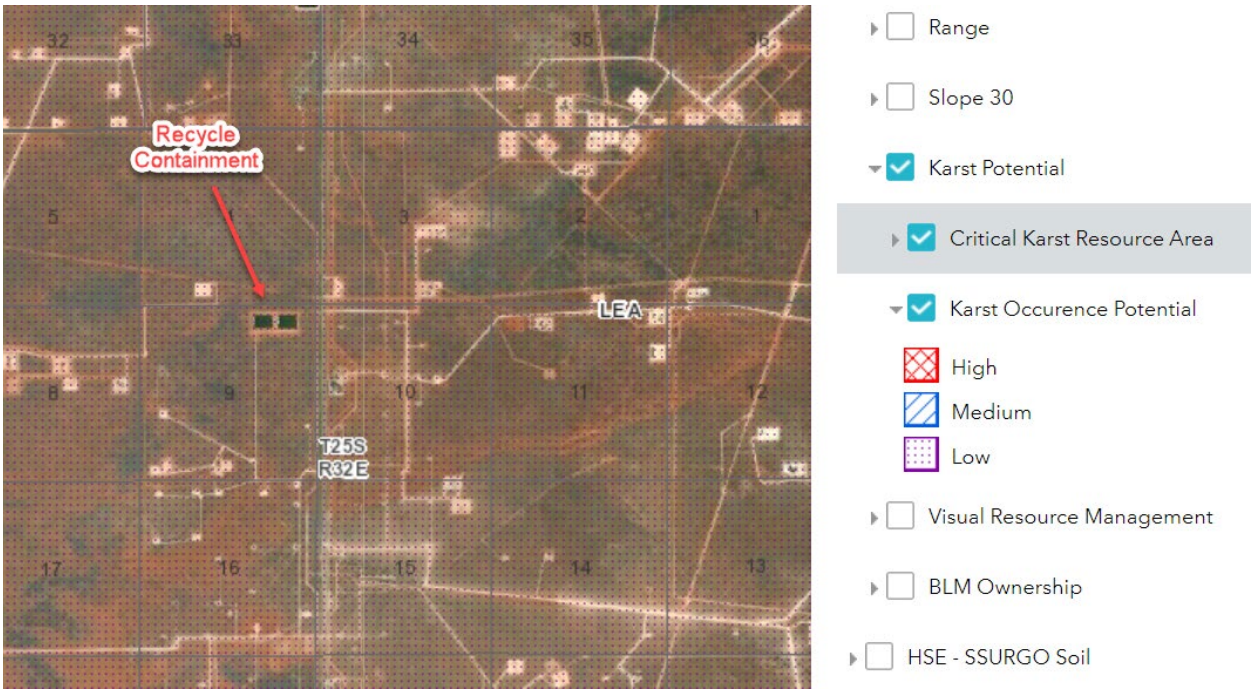
Chevron USA Inc. Cotton Draw T25S R32E Section 9 Recycle Containment/Appendix 2/Figure 5: Municipal Boundaries and Fresh Water Fields

Chevron USA Inc. Cotton Draw T25S R32E Section 9 Recycle Containment/Appendix 2/Figure 6: Subsurface Mines



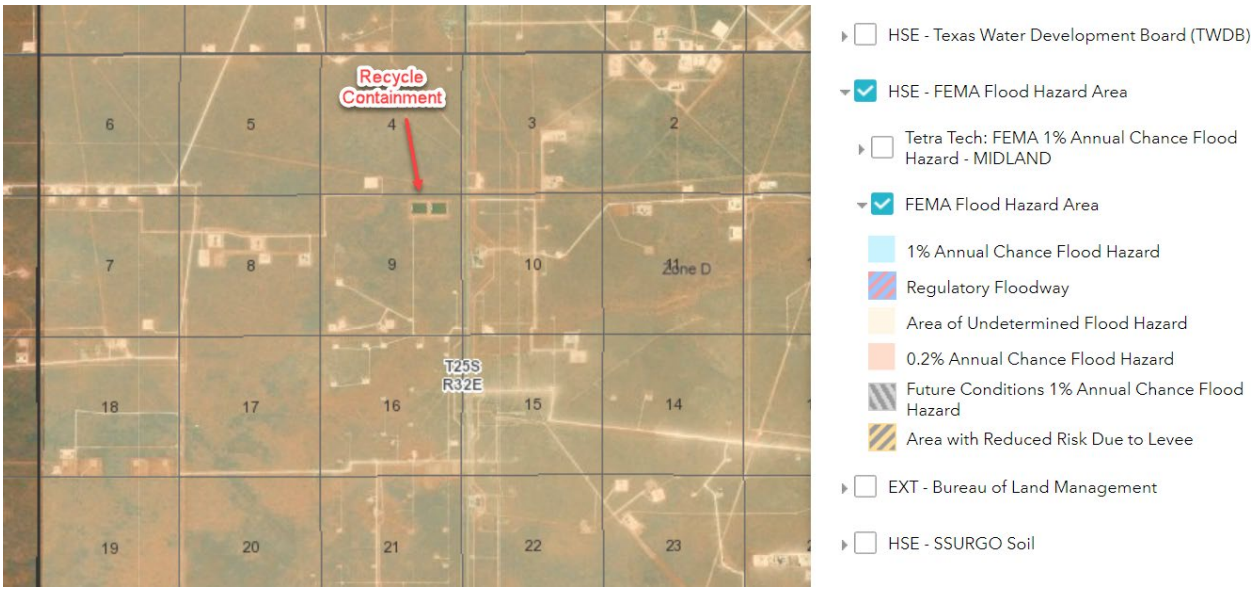
Chevron U.S.A. Inc. | Cotton Draw T25S R32E Recycling Containment

Chevron USA Inc. Cotton Draw T25S R32E Section 9 Recycle Containment/Appendix 2/Figure 7: Cave/Karst Features



Chevron U.S.A. Inc. | Cotton Draw T25S R32E Recycling Containment

Chevron USA Inc. Cotton Draw T25S R32E Section 9 Recycle Containment/Appendix 2/Figure 8: 100-Year Flood Plain



Appendix 3 – Recycling Containment Report of Geotechnical Study

TETRA TECH

Chevron North America – MCBU
Cotton Draw Site

Proposed Two Recycled Water Storage Ponds

Section 9, Township 25 South,
Range 32 East,
Lea County, New Mexico

July 2018

complex world

CLEAR SOLUTIONS™

Report of Geotechnical Study

Cotton Draw Impoundments

Lea County, New Mexico

Prepared for:
Mr. Caleb Weaver
Chevron North America – MCBU
Exploration and Production Company
6301 Deauville Blvd, Midland, TX 79706
Phone: (432) 687-7258

Prepared by:

Tetra Tech

4000 North Big Spring Street, Suite 401
Midland, Texas 79705
Phone (432) 682-4559; Fax (432) 682-3946

Tetra Tech Project No. 212C-MD-01140

Thomas A. Chapel, P.E.
Principal Engineer

Reviewed by: Don Grahlherr,
P.E. Vice President

July 18, 2018

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Chevron North America Exploration and Production Company (Chevron) plans to construct two water storage ponds (or impoundments) at their “Cotton Draw” site located in Lea County, New Mexico. The dimensions of the two water storage ponds (ponds) are approximately 595’L x 410’W and 595’L x 430’W. The ponds will have a maximum operational depth of approximately sixteen feet and total combined capacity of approximately 700,000 barrels (bbl) with three feet of freeboard.

The purpose of this study was to obtain information on subsurface conditions and to provide geotechnical design recommendations for the construction of the two proposed ponds. The general site location is shown on the Site Location Map (Figure 1) and Topographic Map (Figure 2).

Between March 12th and 14nd, 2018, Tetra Tech and our drilling subcontractor drilled five (5) exploratory soil borings to identify subsurface conditions and collect samples. Borings were drilled to depths ranging from 40 feet to 80 feet below the existing ground surface (bgs). Water was not encountered in the borings during or immediately after drilling. The boreholes were backfilled with the excavated soils following competition of drilling. Approximate locations of the borings are shown in Figure 3.

The borings encountered predominantly medium dense to very dense sand to silty sand and silty gravel. Slight cementation of soils was observed at various depths.

Mapping by the Natural Resources Conservation Service (NRCS, 2016) identifies the site soils as the Pyote mapping unit (Figure 4). These soils are described as fine sands. Review of mapping by the U.S. Geological Survey (Figure 5) indicates that the eolian and alluvial deposits cover entirely the project site. Typically, these deposits are a distinctive reddish-brown color and soils are weakly developed. Eolian sediments consist of wind-deposited sand and silt, augmented and modified by alluvial processes.

Our investigation found that subsurface conditions are generally favorable for construction of lined earthen storage ponds at this location. The primary geotechnical concerns are collapsing soils at shallow depths, potentially soft or yielding soils that may develop during construction, and portions of the pond footprint that are underlain by hard, cemented soil/rock lenses.

Additional investigation and construction recommendations for the development of the site are provided in the body of this report.

We have prepared this executive summary solely to provide a general overview, and it should not be used for any purpose except that for which it was intended. We recommend detailed review of the entire report for information about our findings, recommendations and other concerns related to geotechnical conditions for the site.

1.0 PURPOSE AND SCOPE OF STUDY

Chevron North America Exploration and Production Company (Chevron) plans to construct a water storage ponds (or impoundments) at their "Cotton Draw" site located in Lea County, New Mexico. The scope of the study for this project included the following.

1. Request a New Mexico 811 Utility locate;

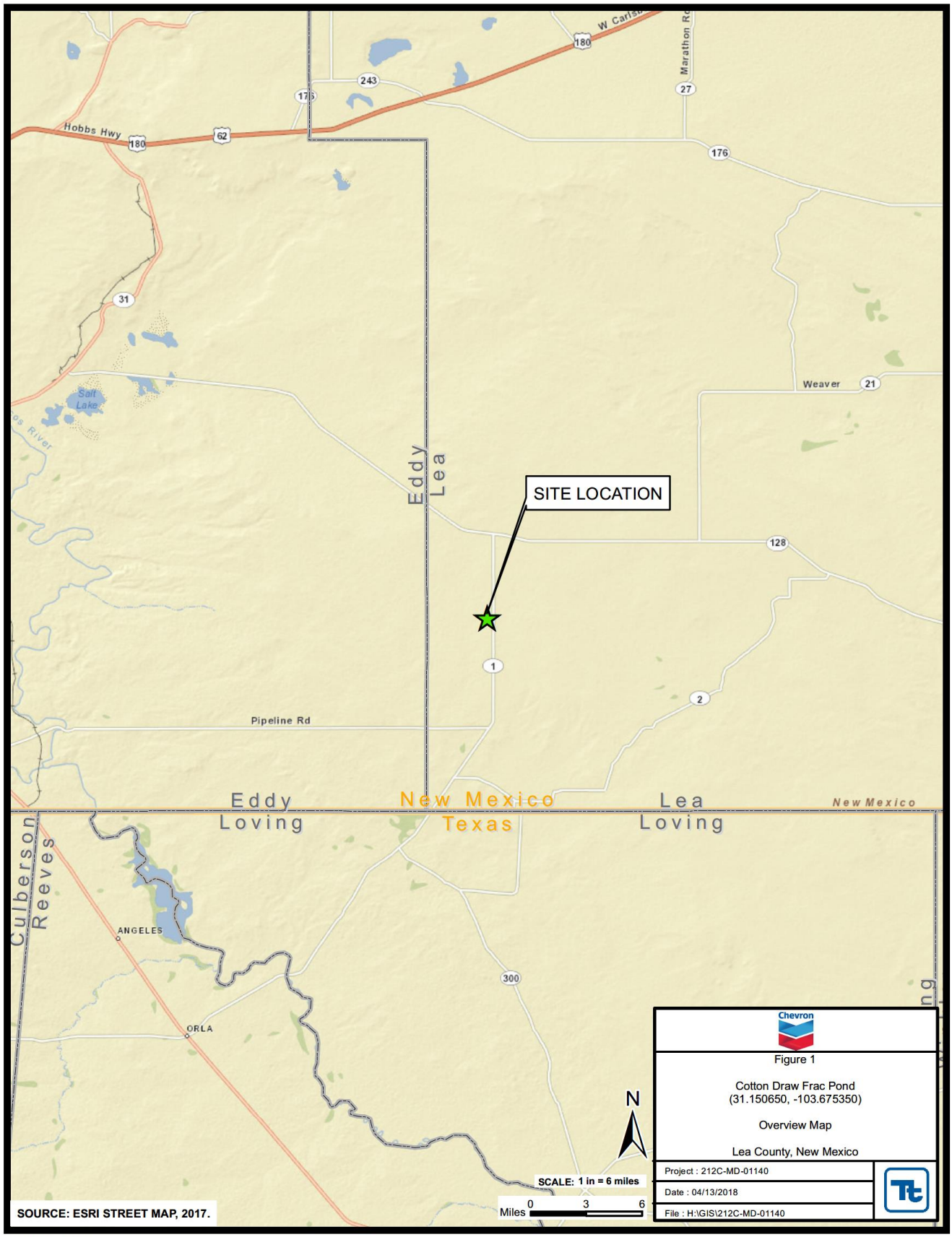
2. Mobilize an air rotary drilling rig to drill four (4) borings to a depth of 40 feet to characterize the subsurface and one (1) boring to a depth of 80 feet, primarily to confirm presence or absence of groundwater;

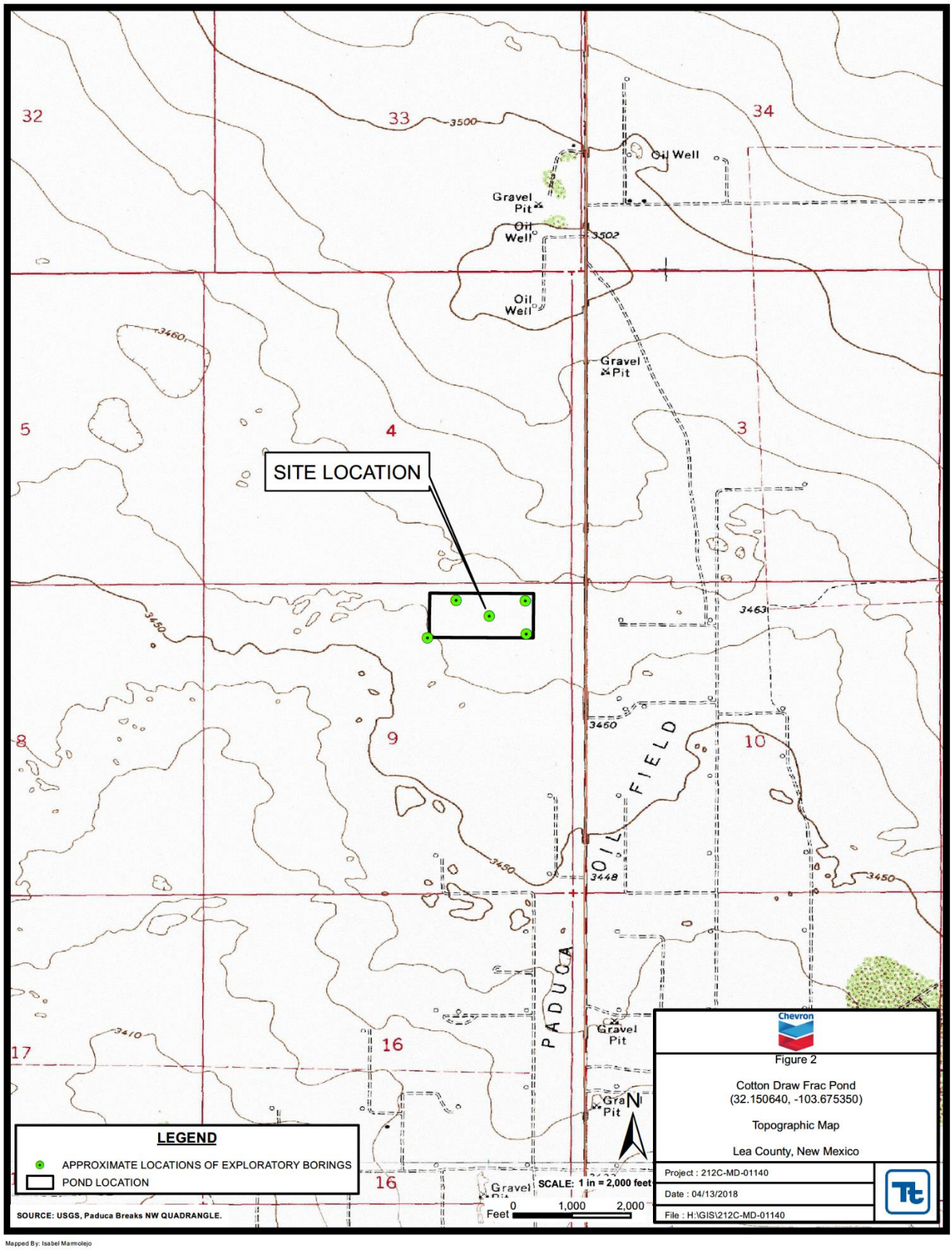
3. Perform Modified California Sampler Tests (MC) at every 5 or 10-foot interval to evaluate soil consistency and collect soil samples for evaluation;

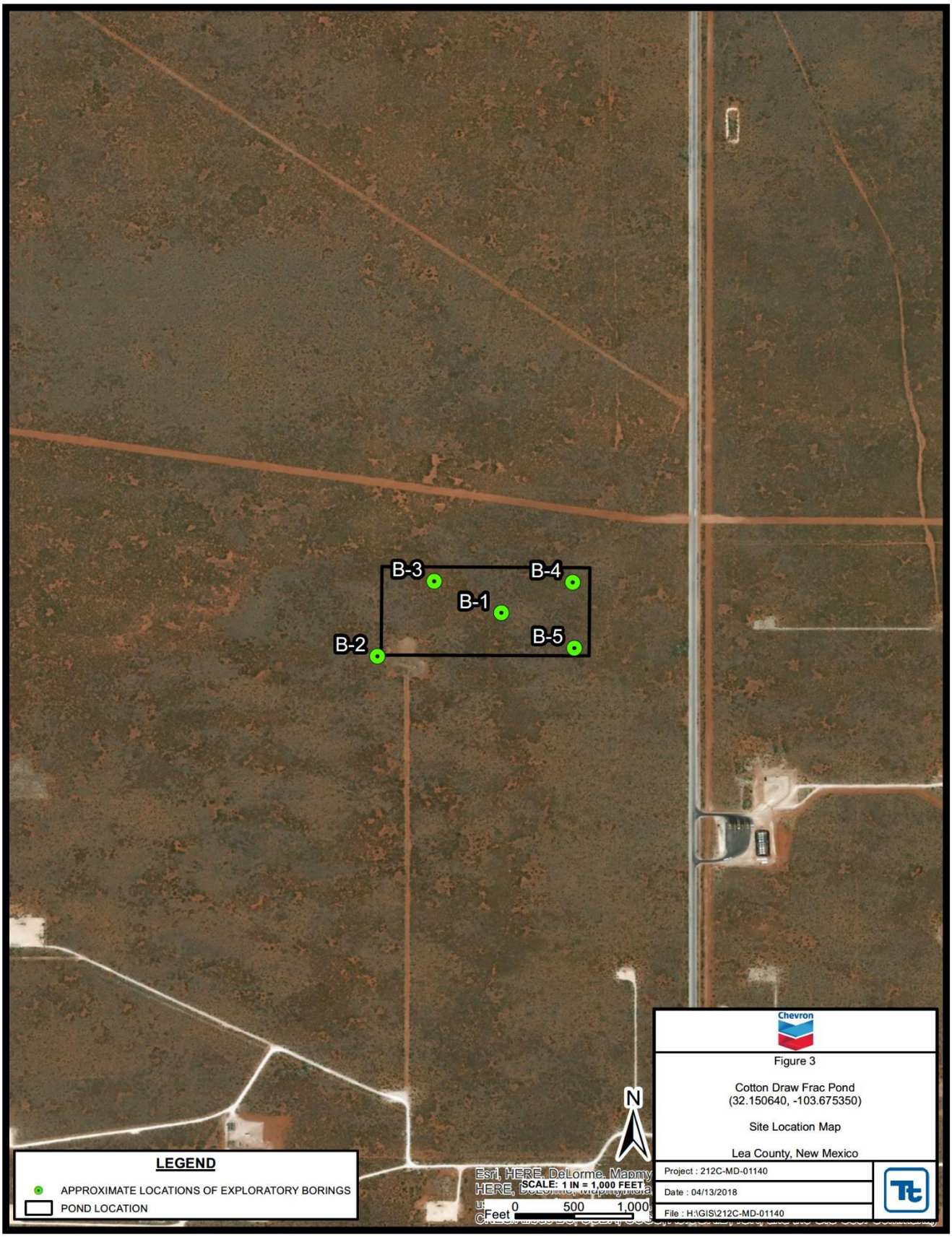
4. Backfill borings with soil cuttings after completion of drilling and 24-hour measurements, as required; and

5. Provide geotechnical engineering design criteria and recommendations and prepare a geotechnical report.

The general location of the site is shown on the Site Location Map, Figure 1 and Topographic Map, Figure 2.


SITE LOCATION
Hobbs Hwy
180
62
243
176
27
Marathon Rd
Weaver
21
31
Salt Lake
Eddy
Lea
128
1
2
Pipeline Rd
Eddy
Loving
New Mexico
Texas
Lea
Loving
New Mexico
Culberson
Reeves
ANGELES
ORLA
300
N
SCALE: 1 in = 6 miles
Miles 0 3 6
SOURCE: ESRI STREET MAP, 2017.
Mapped By: Isabel Marmolejo
Chevron
Figure 1
Cotton Draw Frac Pond
(31.150650, -103.675350)
Overview Map
Lea County, New Mexico
Project : 212C-MD-01140
Date : 04/13/2018
File : H:\GIS\212C-MD-01140


32
33
34
3500
Oil Well
Gravel Pit
Oil Well
3502
Oil Well
3460
Gravel Pit
5
4
3
SITE LOCATION
3463
3450
8
9
10
3460
OIL FIELD
3448
3450
3450
PADUCA
3410
17
16
Gravel Pit
Gravel Pit
16
Gravel Pit
N
LEGEND
APPROXIMATE LOCATIONS OF EXPLORATORY BORINGS
POND LOCATION
SOURCE: USGS, Paduca Breaks NW QUADRANGLE.
SCALE: 1 in = 2,000 feet
0 1,000 2,000
Feet
Chevron
Figure 2
Cotton Draw Frac Pond
(32.150640, -103.675350)
Topographic Map
Lea County, New Mexico
Project : 212C-MD-01140
Date : 04/13/2018
File : H:\GIS\212C-MD-01140
Mapped By: Isabel Marmolejo


B-3
B-4
B-1
B-2
B-5
N
LEGEND
APPROXIMATE LOCATIONS OF EXPLORATORY BORINGS
POND LOCATION
SCALE: 1 IN = 1,000 FEET
Feet 0 500 1,000
Chevron
Figure 3
Cotton Draw Frac Pond
(32.150640, -103.675350)
Site Location Map
Lea County, New Mexico
Project : 212C-MD-01140
Date : 04/13/2018
File : H:\GIS\212C-MD-01140
Mapped By: Isabel Marmolejo

2.0 SITE CONDITIONS

The project site for the proposed water storage impoundments are identified within this report as the Cotton Draw Frac Pond Site. It is located 65 miles southwest of Hobbs in Lea County, New Mexico, and approximately 5 miles south of NM-180 along Orla Rd J-1. GPS coordinates recorded at the NE corner of the site are 32.150565°N and 103.672183°W.

The site was wooded with some mesquite trees, wild shrubs, and weeds, and appeared to be minimally sloped. The immediate surrounding property was undeveloped.

3.0 PROPOSED DEVELOPMENT

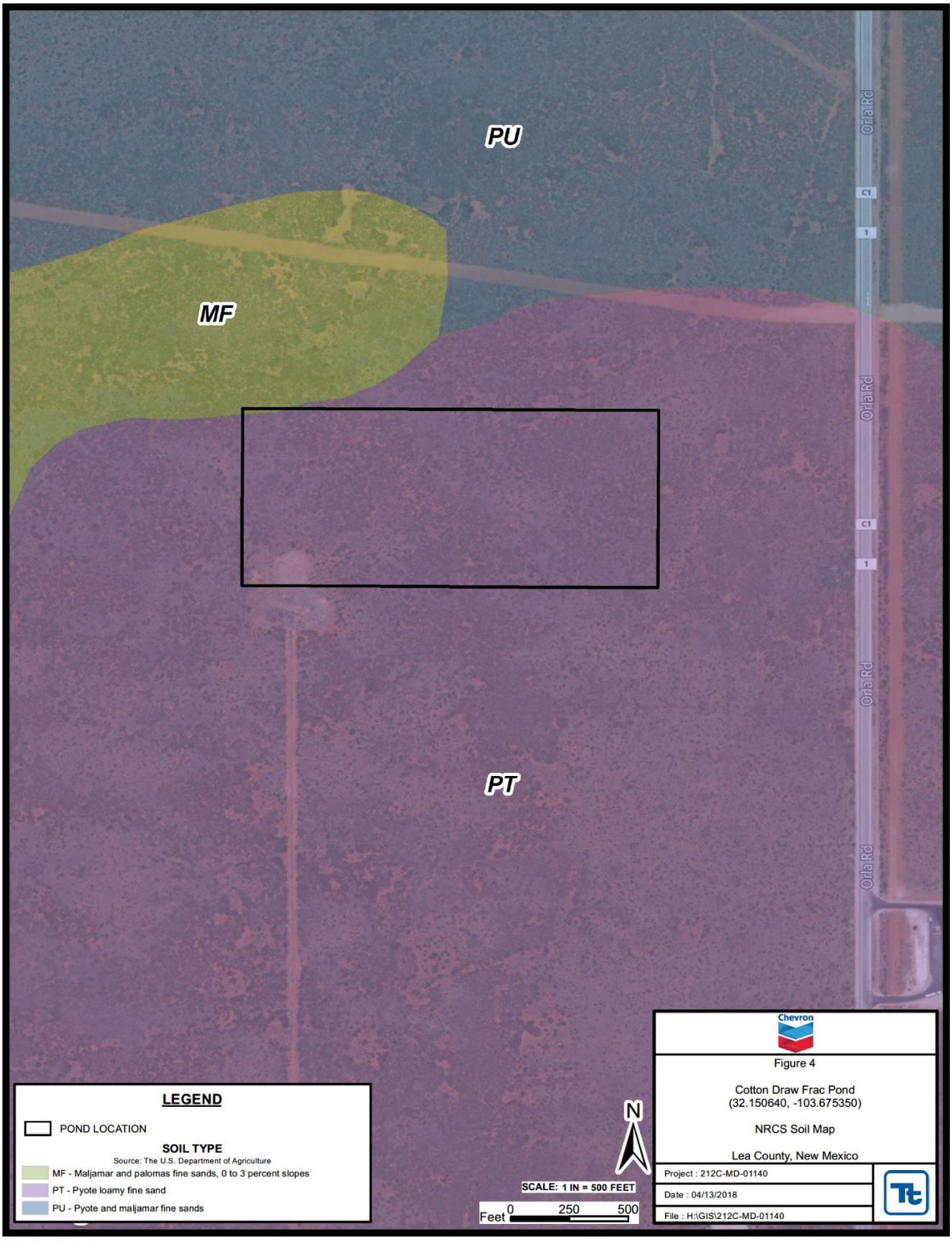
The dimensions of the two water storage ponds (ponds) are approximately 595'L x 410'W and 595'L x 430'W. The ponds will have a maximum operational depth of approximately sixteen feet and total combined capacity of approximately 700,000 barrels (bbl) with three feet of freeboard. The maximum berm height is expected to be 10.5 to 11.5 feet above the lowest adjacent ground. Interior and exterior berm slopes are anticipated to be 3H:1V. We understand that Chevron prefers to balance cut and fill volumes using onsite soil for fill to construct earthen berms for the impoundments and for other site leveling and/or grading improvements required immediately outside the impoundments. The bottom of the ponds will be sloped to drain to an installed liquid leak detection sump.

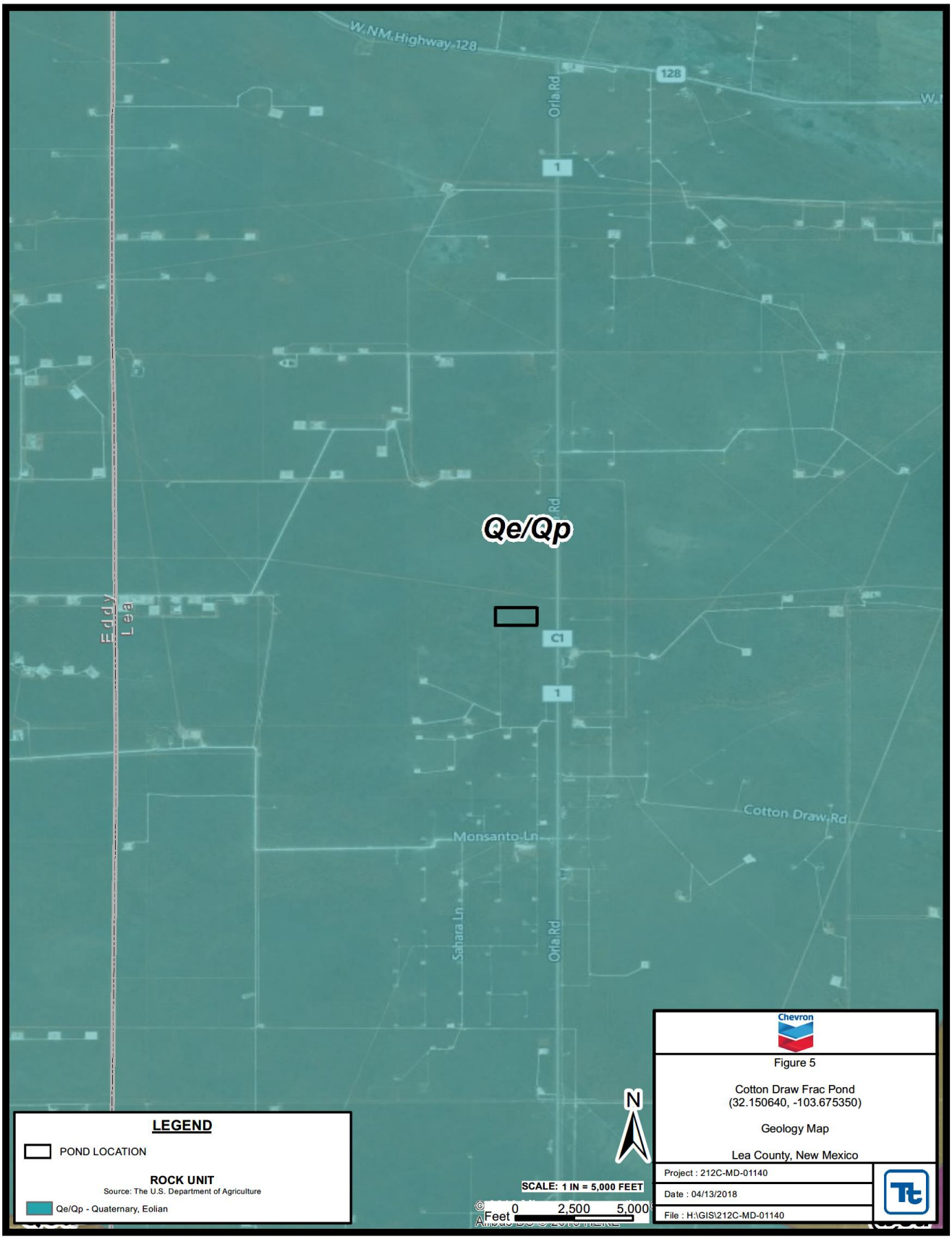
4.0 GEOLOGIC CONDITIONS

Mapping by the Natural Resources Conservation Service (NRCS, 2016) identifies the site soils as the Pyote mapping unit (Figure 4). These soils are described as well draining fine sands.

Review of mapping by the U.S. Geological Survey (Figure 5) indicates that the eolian and alluvial deposits entirely cover the project site. Deposits are typically a distinctive reddish-brown color and soils are weakly developed. Eolian sediments consist of wind-deposited sand and silt, augmented and modified by alluvial processes.

Our findings of the geotechnical study are consistent with this characterization within the depths explored.


PU
MF
PT
Orla Rd
LEGEND
POND LOCATION
SOIL TYPE
Source: The U.S. Department of Agriculture
MF - Maljamar and palomas fine sands, 0 to 3 percent slopes
PT - Pyote loamy fine sand
PU - Pyote and maljamar fine sands
N
SCALE: 1 IN = 500 FEET
Feet 0 250 500
Chevron
Figure 4
Cotton Draw Frac Pond
(32.150640, -103.675350)
NRCS Soil Map
Lea County, New Mexico
Project : 212C-MD-01140
Date : 04/13/2018
File : H:\GIS\212C-MD-01140
Mapped By: Isabel Marmolejo


W.NM.Highway.128
128
Orla Rd
1
Qe/Qp
Eddy
Lea
C1
1
Cotton Draw Rd
Monsanto Ln
Sahara Ln
Orla Rd
N
LEGEND
POND LOCATION
ROCK UNIT
Source: The U.S. Department of Agriculture
Qe/Qp - Quaternary, Eolian
SCALE: 1 IN = 5,000 FEET
Feet 0 2,500 5,000
Chevron
Figure 5
Cotton Draw Frac Pond
(32.150640, -103.675350)
Geology Map
Lea County, New Mexico
Project : 212C-MD-01140
Date : 04/13/2018
File : H:\GIS\212C-MD-01140
Mapped By: Isabel Marmolejo

5.0 EXPLORATORY SOIL BORINGS

Tetra Tech drilled five (5) exploratory soil borings (B-1 through B-5) between March 12th and 14th, 2018 to identify subsurface conditions at the site. The boring locations were selected by a representative from Tetra Tech using a Google Earth map and proposed site development layout provided by Chevron. The proposed ponds footprint was overlaid on the satellite image, and GPS coordinates were obtained for each boring location. The boring locations were marked in the field by Tetra Tech using these coordinates and a commercially available handheld GPS unit. The boring locations were cleared for drilling by comparing the proposed locations to buried utility locations marked by New Mexico 811 utility locating services. In addition, Tetra Tech cleared the boring locations using hand-held pipeline locating instruments.

The borings were drilled by TWE Drilling using a track-mounted drilling rig. The ground surface was soft and sandy requiring a track-mounted drilling rig to access the boring locations. Limited access issues were encountered such as negotiating around obstacles (shrubs and bushes) and the use of sand mats on one occasion. Tetra Tech's representative was on site to view site conditions, observe the drilling, and log the samples.

Air Rotary drilling equipment was used to complete the borings. Borings B-2 through B-5 were drilled to a depth of approximately 40 feet below the existing ground surface (bgs). Boring B-1 was drilled to an approximate depth of 80 feet bgs to investigate the presence or absence of groundwater.

Water was not encountered in the borings while drilling or immediately afterwards. The boreholes were backfilled with the excavated soils following competition of drilling and water level measurements.

Samples obtained during the field exploration were taken to Tetra Tech's laboratory where they were examined and visually classified according to the Unified Soil Classification System (USCS) as described by ASTM D 2487. Representative samples were selected for testing to determine the engineering and physical properties of the soils in general accordance with ASTM or other approved procedures. Tests included water content, dry density, particle size distribution, Atterberg limits, triaxial strength testing, moisture-density relationship, consolidation, and chemical analysis for corrosion potential. The results of the laboratory tests are discussed below and presented in Appendix B.

A California-style sampler was used to collect soil samples at depths of 1.5, 3.5, 6, 8.5, 13.5, 18.5, 23.5, 28.5, 33.5 and 38.5 feet. A 140-pound weight falling 30 inches was used to drive the sampler into the undisturbed soils and bedrock. After "seating" the sampler into undisturbed soil, the number of blows required to drive the sampler in sequential 6-inch intervals was recorded similar to the Standard Penetration Test (SPT) (ASTM D 1586). The number of blows for each 12-inch interval (N-value) was recorded on the logs and was used to categorize the consistency of the soil. The N-values were corrected for

the larger diameter of the modified California style sample barrel. A total of three thin walled “Shelby tube” samples were also collected at depths ranging from 3 to 10 feet depth in borings B-2, B-3, and B-4.

After drilling and sampling activities were complete the borings were backfilled with soil cuttings. The soil boring logs are presented in Appendix A, and approximate locations of the borings are shown in Figure 3.

6.0 SUBSURFACE CONDITIONS

The information from the borings indicates the subsurface conditions included varying thicknesses and consistency of silty sand, sandy and silty gravel, and poorly graded silty sand beneath minimal vegetation and topsoil. At various depths, slight to strong cementation of soils was observed.

The in-situ moisture content of the samples ranged from 2.6 to 6.3 percent and the in-situ dry density ranged from 90.2 pounds per cubic foot (pcf) to 107.6 pcf. Laboratory tests showed the fines content (percent passing the #200 sieve) for all samples ranged from 5 to 31 percent indicating coarse grained soils according to the Unified Soil Classification System (USCS). The fines content generally decreased with depth. Atterberg limits testing of the silty sand and gravel soils indicates non-plastic soils. One test on a sample from boring B-3 at a depth of 6.5 feet resulted in a Liquid Limit (LL) of 21 and a Plasticity Index (PI) of 4.

Consolidation testing of the specimen from B-1 at 3.5 feet bgs indicated a volume decrease of 2.1 percent when inundated with water under a load similar to the existing overburden pressure. The compression index (Cc) was calculated to be 0.2 and the swell index (Cs) was calculated to be 0.025. Consolidation testing on the specimen from B-5 at 3.5 feet indicated a volume decrease of 1.7 percent when inundated with water under a load similar to the existing overburden pressure. The Cc and Cs were calculated to be 0.17 and 0.021, respectively. These results indicate a low risk of collapse for the soils tested.

Permeability testing of a sample from B-3 at 6.5 feet bgs indicated a hydraulic conductivity of 3.0×10^{-3} cm/s.

A bulk sample (TP-1) from a depth of approximately 5 feet had an optimum moisture content of 12.5 percent and a maximum dry density of 117.8 pounds per cubic foot (pcf) determined by the Standard Proctor test method (ASTM D698).

7.0 ENGINEERING ANALYSES AND RECOMMENDATIONS

7.1 Primary Geotechnical Considerations

The primary concern that could impact the proposed development are the presence of desiccated silty and sandy soils that could include zones of collapse prone soils, degradation of subgrade or recompacted soils under construction equipment traffic, and potential zones or lenses of cemented materials across the proposed pit footprint that may cause challenging excavation. These are discussed in greater detail below.

The on-site soils are generally susceptible to degradation under construction equipment traffic, especially when exposed to high moisture levels. Site soils may lose strength and stability over a narrow range of water content. Excessive pumping and rutting may occur during construction operations when such changes occur, especially under repeated traffic loads. Necessary precautions should be made to avoid excessive degradation of the subgrade soils. If such conditions develop, it may be necessary to use more lightly loaded track mounted equipment in lieu of heavy rubber tired equipment.

Laboratory testing indicates that shallow silt and sandy soils. Laboratory testing indicated a collapse of 1.7 to 2.1 percent, which we opine will be mitigated by typical construction traffic and procedures. Further, preliminary designs indicate that the base of the ponds will be approximately 6 to 7 feet below the existing ground surface, not including a small 4’ deep leak detection sump, which will extend below the base of the ponds. It appears that depth will be below the collapse prone zone and therefore no special subgrade treatment or preparation will be needed. However, a representative of Tetra Tech should be present during excavation of the ponds to view the soils as they are exposed in order to confirm our assumption. If brittle soils with visible void structure are encountered at the base or in pit sidewalls, over-excavation and recompaction of the subgrade may be required to reduce the risk of damage to the liner system.

7.2 Site Preparation

To prepare the site for pond construction, an area larger than the proposed footprint by at least 10 feet in plan dimension on all sides should be stripped of vegetation, roots, organic material, existing construction materials, debris, and other unsuitable materials. A typical stripping depth is approximately 6 inches; however, the actual depth will vary and should be based on field conditions and observations. After stripping, we anticipate a moderately stable surface for support of construction equipment. Unsuitable areas (such as those with loose, wet, soft, yielding, and/or pumping subgrade) should be corrected before construction proceeds.

Obstructions that could hinder preparation of the site should also be removed, with special attention given to unknown or un-documented below ground appurtenances and any existing above and below ground flow lines. Care should be taken not to damage any existing buried utilities located within the footprint of the proposed construction. Any

resulting utility trenches/excavations due to replacement or relocation of utilities should be backfilled as discussed in the Fill Placement and Compaction section of this report.

7.3 Excavation and Embankment Slopes

Based on the subsurface data, sandy soils with varying degrees of cementation are present to depths of at least 80 feet below the existing grade. Conventional construction equipment can be used to excavate the ground within the planned depths of the ponds. However, excavation into the cemented soils will be more difficult and additional effort or large, heavy duty equipment may be necessary. Heavy duty rock ripping equipment like a ripper mounted on a Caterpillar D8 bulldozer or equivalent may be required in some areas.

The earthwork contractor should review the subsurface conditions and appropriately select excavation equipment and initial slope of the excavation to minimize potential sloughing and to remain in compliance with OSHA Regulations 1926.651 and 1926.652 on excavation safety. Wetting of the exposed excavation sides to a moisture content near or slightly above optimum may be necessary to stabilize and maintain the slopes during construction.

During construction, the excavation slopes should be observed for safety purposes. Excavation slopes specified by OSHA are dependent on types of soil and groundwater conditions encountered. Based on our investigation the on-site soil is classified as Type C, and the cemented soils can be considered Type A or Type B soils according to OSHA 1926, Subpart P, Appendix A. In a layered environment the Type C soils will control excavation slopes. The contractor's "competent person" should identify the soils encountered in the excavation and refer to OSHA 1926.651 and 1926.652 to verify the conditions and classifications from our investigation and determine appropriate slopes. If deemed unstable, the excavation sides should be flattened or benched to remain in compliance. Stockpiles of soils and equipment should not be placed within a horizontal distance equal to one-half the excavation depth, from the edge of the excavation. Excavations deeper than 20 feet should be designed by a Professional Engineer as recommended by OSHA

Limited slope stability analyses were performed and show that the proposed 3H:1V slopes meet or exceed minimum acceptable factors of safety. We recommend 3H:1V slopes based on consideration of other issues such as constructability, maintenance, and liner stability. If Chevron would like to consider construction of slopes steeper than the 3H:1V recommended above, Tetra Tech is available to conduct additional slope stability analysis to evaluate the feasibility of steeper slopes and liner system performance on those slopes. This analysis would be supported by slope stability modeling and hand calculations to present to the New Mexico Oil Conservation District (NMOCD) in a variance request.

7.4 Fill Placement and Compaction

On-site soils free of rocks greater than 1 inch in diameter, organics, and debris are suitable for use as structural fill or backfill. Cemented soils, where encountered will likely require additional processing beyond ripping to achieve a soil consistency and meet the maximum particle size dimension in the construction specifications. On-site, natural or processed soils containing some rocks up to 3 inch diameter may be used in general structural fill not in contact with the liner if an experienced, qualified geotechnical engineer or their geotechnical technician is present during construction to confirm the larger grain size fraction is limited such that the finer soil fraction fills all voids and no “nesting’ of larger materials occur in the compacted fill.

Fill and backfill should not be placed on organics or other deleterious materials such as soil or rock with soluble components such as gypsum. If additional fill is needed for construction of the embankment, imported fill should be a well-graded clayey sand (SC) or low plasticity clay (CL), or imported soils with engineering properties that are similar to on-site soils (depending on the intended use of the fill). Prior to importation, samples of soils being considered as fill should be examined and evaluated by a geotechnical engineer for engineering properties to determine the suitability of the material for its intended use.

The bases of fills should be scarified at least 8 inches deep, moisture-conditioned or dried to within 2 percent of optimum moisture content, processed to a uniform condition, and then compacted to at least 95 percent of maximum dry density determined by standard Proctor (ASTM D698). For on-site and imported fill and backfill, moisture should be adjusted to within two percent of optimum moisture content as determined by standard Proctor and the soils thoroughly mixed prior to placement and compaction to provide uniform water content throughout the fill.

Fill and backfill should be placed in uniform lifts of 8 inches or less in loose thickness and compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D 698). Fill should be compacted using heavy vibratory equipment. In areas with limited space for heavy equipment, appropriate compaction equipment such as a jumping jack or other hand tools should be used. Where smaller compacting equipment or hand tools are used, the fill lifts should be 6 inches or less in loose thickness. The contractor should select the equipment type based upon the fill soil conditions.

Placement and compaction of fill should be observed and tested by a qualified geotechnical engineer or their qualified representative during construction. Each vertical foot of compacted fill placed should be tested for compaction comparison to standard Proctor results. A minimum of one moisture/density verification test should be performed for every 5,000-square-feet of compacted area, or for every 150-lineal feet of utility trench backfill. For smaller areas, a minimum of 3 verification tests should be conducted for every lift. Subsequent lifts should not be placed until the exposed lift has been tested to confirm compliance with the specified moisture and density. Lifts failing to meet the moisture and density requirements should be reworked to meet the required specifications prior to

subsequent lifts being placed. Density and moisture verification testing is recommended to provide an indication that adequate earthwork is being performed. However, the quality of the fill and compaction is the sole responsibility of the contractor. Satisfactory verification testing is not a guarantee of the quality of the contractor's earthwork operations.

The specified moisture content must be maintained until compaction of the overlying lift, or until the cushioning sand layer or geotextile fabric and geomembrane liner are installed. Failure to maintain the specified moisture content could result in excessive soil movement resulting in embankment failure. The contractor must provide some means of controlling the moisture content (such as water hoses, water trucks, etc.). Maintaining subgrade moisture is always critical, but will require the most effort during warm, windy and/or sunny conditions.

7.5 Proof Rolling

Proof rolling of the subgrade prior to fill placement and liner installation should be used to detect areas of soft and/or pumping soil. Proof rolling should be conducted using a heavy, rubber-tired vehicle weighing at least 25 tons, with the tires inflated to the manufacturer’s specified operating pressure. The entire area should be proof rolled, with each succeeding pass offset by not greater than one tire width. The geotechnical engineer or an experienced soils technician should be present during proof rolling activities to assist with the identification of unsuitable soil. Unsuitable soil should be undercut and reworked, or otherwise improved in a manner that is suitable to the design and approved by the geotechnical engineer.

7.6 Geomembrane Liner Protection

Where the exposed surface is rough, rock protrusions and sharp edges can potentially damage the geomembrane liner. An irregular foundation with voids can create localized stress points on the geomembrane liner. The subsurface conditions at this site indicate a mix of silty, sandy, and gravelly soils. However, the pond bottom might be underlain by areas of cemented soil with rock-like protrusions and surface irregularities across pond footprint. To protect the liner against punctures, structural fill free of rocks greater than 1 inch in diameter should be used within 1 foot of the liner subgrade and a cushion, such as a fine-grained sand layer, approximately 6 inches thick or a properly designed cushion geotextile should be installed below the liner in accordance with manufacturer recommendations. Liner requirements must meet those presented in the New Mexico Administrative Code (NMAC) 19.15.36.17.

7.7 Freeboard

An important aspect of embankment stability and performance is maintaining the appropriate freeboard (the vertical distance from the water surface to the crest of the embankment). If the freeboard is insufficient, the embankment could overtop, leading to excessive erosion and possible failure. The NMAC 19.15.36.17 regulations and MCBU General Standards require a minimum freeboard of three feet which must be maintained at all times. Based on the surface area of the ponds, we opine three feet of freeboard is adequate to protect against overtopping due to precipitation or wave run up.

7.8 Settlement of Subgrade and Embankment Materials

Settlement of embankment material is another important aspect of embankment stability and total fluid storage potential over time. It is anticipated that the embankments will be constructed of fill consisting of on-site material or imported fill. The on-site sandy soils have a relatively low potential for post-construction settlement, however the site soils have collapse potential, as discussed in this report (see Section 7.1 above). A representative of Tetra Tech should be present during excavation of the ponds to view the soils as they are exposed in order to confirm that soil conditions are consistent with our assumptions. If brittle soils with visible void structure are encountered at the base or in pit sidewalls, over-excavation and recompaction of the subgrade may be required to reduce the risk of damage to the liner system.

Construction recommendations described above for proof rolling, subgrade improvements, and fill placement will mitigate collapse and reduce the amount of settlement.

7.9 Permitting

If applicable, a permit application should be filed with the NMOCD in accordance with NMAC regulations prior to construction. Construction and installation in accordance with NMOCD regulations found in the NMAC and the design drawings and construction specifications is recommended. The NMOCD may require notification prior to construction and prior to operation of the ponds.

8.0 CONCLUSIONS

Our investigation found that subsurface conditions are generally favorable for construction of lined earthen storage ponds at this location. Construction in accordance with the recommendation of Section 7 in this report can mitigate the primary geotechnical concerns: collapsing soils at shallow depths, potentially soft or yielding soils that may develop during construction, and portions of the pond footprint that are underlain by hard, cemented soil/rock lenses.

We recommend designing the side slopes at an inclination of 3 horizontal to 1 vertical (3H:1V), which is consistent with New Mexico regulations, which state that the maximum allowed pond embankment slope is 3H:1V for exterior slopes and 2H:1V for interior slopes. New Mexico regulations do allow for variance if steeper slopes are required by the owner.

We recommend a cushion, such as a fine-grained sand layer, approximately 6 inches thick or a properly designed cushion geotextile below the liner to reduce the risk of damage to the liner. Liner requirements must meet those presented in the New Mexico Administrative Code (NMAC) 19.15.36.17.

9.0 LIMITATIONS

This report was prepared from data developed during our field exploration, laboratory testing, and engineering judgment. Our design recommendations were based on subsurface data and our experience with similar projects and subsurface conditions. Our borings were located to obtain a reasonable interpretation of subsurface conditions. It should be noted that the borings were widely spaced and variation in the subsoils between borings is likely.

A Tetra Tech geotechnical engineer or their designated representative should observe the construction to look for evidence that would indicate differences in subsurface conditions from those described in this report. If any information becomes available that would alter our assumptions, conclusions or recommendations, the opinions presented in this report should be considered invalid until we have been contacted to review our recommendations based on the new information. The geotechnical engineer should review plans and specifications during the design. Placement and compaction of engineered fill, backfill, subgrade and other fills should be observed and tested by a representative of a Construction Materials Testing (CMT) firm during construction, and Tetra Tech should be retained to review these data.

We believe this study was conducted in a manner consistent with that level of skill and care ordinarily used by members of the profession currently practicing under similar conditions in the locality of this project. No warranty, express or implied, is made. If we can be of further service in discussing the contents of this report or in the analysis of the planned project from the geotechnical point of view, please contact us.

10.0 REFERENCES

[1] U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS, 2016). Web Soil Survey. Accessed October 10, 2017. http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.

[2] United States Geological Survey (USGS, 2005). Preliminary Integrated Geologic Map for the United States Central States. Open-File Report 2005-1351

APPENDIX A

EXPLORATORY BORING LOGS

TETRA TECH
Tetra Tech Inc.
4000 N. Big Spring, Suite 401
Midland, TX, 79705
Telephone: 432-682-4559
Fax: 432-682-3946

BOREHOLE ID: B-1

CLIENT Chevron **PROJECT NAME** Cotton Draw Frac Pond

PROJECT NUMBER 212C-MD-01140 **PROJECT LOCATION** Lea County, New Mexico

DATE(S) OF DRILLING: 03/13/2018 **GROUND ELEVATION: NA** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech, Inc. **LATITUDE: 32.150640 N** **LOGGED BY: Clint Merritt**

DRILLING CONTRACTOR: TWE **LONGITUDE: 103.675350 W** **DRILLED BY: Keith Barge**

Notes: No groundwater encountered. Blow counts have been corrected for sampler diameter. Refusal at 30 ft, borehole was offset 50 ft to SE (32.150582 N, 103.67531 W) and drilled to 80 ft to check for water.

DEPTH (ft)	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0							
	CA 1	100	7-10-10		SM		Medium Dense to Dense, Light Brown, Fine Grained **SILTY SAND**, Dry
5	CA 2	100	13-13-11	MC = 4.8% DD = 90.2 pcf LL = NP PL = NP PI = NP Fines = 30.8%			
	CA 3	100	9-18-25				
							8.0
10	CA 4	0	35-50/4"				Medium Dense to Very Dense, Pink, Fine Grained **SILTY GRAVEL**, Dry with 20% of Caliche/Sandstone
15	CA 5	67	10-10-13				
20	CA 6	61	8-50/5"	MC = 3.1% LL = NP PL = NP PI = NP Fines = 10.7%	GP-GM		
25	CA 7	61	15-50/5"				
30	CA 8	61	7-10-15	MC = 3.0% LL = NP PL = NP PI = NP Fines = 5.1%	GP-GM		30.0
35							Dense to Very Dense, Pink, Coarse Grained **SANDY GRAVEL**, Dry
40							

BOREHOLE/TP/WELL - TT CHEVRON COTTON DRAW FRAC POND.GPJ LAB SUMMARY.GDT 7/5/18

(Continued Next Page)

TETRA TECH
Tetra Tech Inc.
4000 N. Big Spring, Suite 401
Midland, TX, 79705
Telephone: 432-682-4559
Fax: 432-682-3946

BOREHOLE ID: B-1

CLIENT Chevron **PROJECT NAME** Cotton Draw Frac Pond

PROJECT NUMBER 212C-MD-01140 **PROJECT LOCATION** Lea County, New Mexico

DEPTH (ft)	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
40							Dense to Very Dense, Pink, Coarse Grained **SANDY GRAVEL**, Dry *(continued)*
45							
50							
55							
60							
65							
70							
75							
80							80.0 Borehole terminated at 80.0 ft.

BOREHOLE/TP/WELL - TT CHEVRON COTTON DRAW FRAC POND.GPJ LAB SUMMARY.GDT 7/5/18

Tetra Tech Inc.
4000 N. Big Spring, Suite 401
Midland, TX, 79705
Telephone: 432-682-4559
Fax: 432-682-3946

BOREHOLE ID: B-2

CLIENT Chevron **PROJECT NAME** Cotton Draw Frac Pond

PROJECT NUMBER 212C-MD-01140 **PROJECT LOCATION** Lea County, New Mexico

DATE(S) OF DRILLING: 03/12/2018 **GROUND ELEVATION: NA** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech, Inc. **LATITUDE: 32.149630 N** **LOGGED BY: Clint Merritt**

DRILLING CONTRACTOR: TWE **LONGITUDE: 103.678240 W** **DRILLED BY: Keith Barge**

Notes: No groundwater encountered. Blow counts have been corrected for sampler diameter.

DEPTH (ft)	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0							
	CA 1	100	7-10-10	MC = 5.0% DD = 104.2 pcf Fines = 20.7% Eff. Phi = 34.5 deg Eff. C = 0 psf Tot. Phi = 31.9 deg Tot. C = 0 psf			Medium Dense, Light Brown, Fine Grained **SILTY SAND**, Dry
	CA 2	100	5-3-4				3.0
5					SM		Medium Dense, Light Brown, Fine Grained **SILTY SAND**, Dry, Plastic
	ST 1	100		MC = 4.2% LL = NP PL = NP PI = NP Fines = 13.2%			7.0
							Medium Dense, Pink, Fine Grained **SILTY SAND**, Dry
10	CA 3	100	10-10-12				
15	CA 4	100	10-10-12				15.0
20	CA 5	28	50/5"				Very Dense, Pink, Coarse Grained **SANDY GRAVEL**, Dry
25	CA 6	0	50/0"				
30	CA 7	0	25-50/0"				30.0
35	CA 8	67	27-50/5"				Very Dense, Light Brown, Fine Grained **SILTY SAND**, Dry, 30% of Strong Cementation, Some Gravel
40	CA 9	22	50/4"				40.0

Borehole terminated at 40.0 ft.

BOREHOLE/TP/WELL - TT CHEVRON COTTON DRAW FRAC POND.GPJ LAB SUMMARY.GDT 7/5/18

Tetra Tech Inc.
4000 N. Big Spring, Suite 401
Midland, TX, 79705
Telephone: 432-682-4559
Fax: 432-682-3946

BOREHOLE ID: B-3

CLIENT Chevron **PROJECT NAME** Cotton Draw Frac Pond

PROJECT NUMBER 212C-MD-01140 **PROJECT LOCATION** Lea County, New Mexico

DATE(S) OF DRILLING: 03/13/2018 **GROUND ELEVATION: NA** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech, Inc. **LATITUDE: 32.151371 N** **LOGGED BY: Jeremy Worrell**

DRILLING CONTRACTOR: TWE **LONGITUDE: 103.676916 W** **DRILLED BY: Keith Barge**

Notes: No groundwater encountered. Blow counts have been corrected for sampler diameter.

DEPTH (ft)	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0							
	CA 1	61	4-10-8				Medium Dense, Brown, Fine Grained **SILTY SAND**, Dry
3.0							
5	CA 2	89	9-14-21		SC-SM		Medium Dense to Dense, Brown to Light Brown, Fine Grained **CLAYEY SILTY SAND**, Dry, Weakly Cemented
7.0							
	CA 3	100	8-8-14	MC = 5.1% DD = 101.5 pcf LL = 21 PL = 17 PI = 4 Fines = 24.9%			Very Dense, Pink to White, Fine Grained **SILTY SAND**, Dry, Some Gravel
10	ST 1						
15	CA 4	33	50/2"				
15.0							
							Dense to Very Dense, Brown to Light Brown, Fine Grained **SILTY SAND**, Dry, Some Caliche and Gravel
20	CA 5	67	27-27-17	MC = 4.2% DD = 93.1 pcf LL = NP PL = NP PI = NP Fines = 14.6%	SM		
25	CA 6	83	18-50/3"				
30	CA 7	17	50/3"				
35							
40	CA 8	17	50/2"				
40.0							

Borehole terminated at 40.0 ft.

BOREHOLE/TP/WELL - TT CHEVRON COTTON DRAW FRAC POND.GPJ LAB SUMMARY.GDT 7/5/18

Tetra Tech Inc.
4000 N. Big Spring, Suite 401
Midland, TX, 79705
Telephone: 432-682-4559
Fax: 432-682-3946

BOREHOLE ID: B-4

CLIENT Chevron **PROJECT NAME** Cotton Draw Frac Pond

PROJECT NUMBER 212C-MD-01140 **PROJECT LOCATION** Lea County, New Mexico

DATE(S) OF DRILLING: 03/14/2018 **GROUND ELEVATION: NA** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech, Inc. **LATITUDE: 32.151354 N** **LOGGED BY: Jeremy Worrell**

DRILLING CONTRACTOR: TWE **LONGITUDE: 103.673683 W** **DRILLED BY: Keith Barge**

Notes: No groundwater encountered. Blow counts have been corrected for sampler diameter.

DEPTH (ft)	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					SP-SM		Medium Dense, Brown, Poorly Graded **SILTY SAND**, Dry
	CA 1	100	3-5-7	MC = 2.6% DD = 93.2 pcf LL = NP PL = NP PI = NP Fines = 10.1%			
5	ST 1	50					
							3.0 Medium Dense to Dense, Brown to Light Brown, Fine Grained **SILTY SAND**, Dry, Weakly Cemented, Some Caliche, HCl Reactive
	CA 2	89	12-12-16				
10	CA 3	67	10-50/5"				8.0 Dense to Very Dense, Pink to White, Fine Grained **SILTY SAND**, Dry, with Strongly Cemented Caliche and Some Gravel
					SM		
15	CA 4	100	12-18-14	MC = 3.2% LL = NP PL = NP PI = NP Fines = 14.1%			
20	CA 5	78	3-14-8				
25	CA 6	83	9-11-16				
30	CA 7	0	8-50/5"				
35							
40	CA 8	33	14-50/5"				40.0

Borehole terminated at 40.0 ft.

BOREHOLE/TP/WELL - TT CHEVRON COTTON DRAW FRAC POND.GPJ LAB SUMMARY.GDT 7/5/18

TETRA TECH
Tetra Tech Inc.
4000 N. Big Spring, Suite 401
Midland, TX, 79705
Telephone: 432-682-4559
Fax: 432-682-3946

BOREHOLE ID: B-5

CLIENT Chevron **PROJECT NAME** Cotton Draw Frac Pond

PROJECT NUMBER 212C-MD-01140 **PROJECT LOCATION** Lea County, New Mexico

DATE(S) OF DRILLING: 03/14/2018 **GROUND ELEVATION: NA** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech, Inc. **LATITUDE: 32.149814 N** **LOGGED BY: Jeremy Worrell**

DRILLING CONTRACTOR: TWE **LONGITUDE: 103.673647 W** **DRILLED BY: Keith Barge**

Notes: No groundwater encountered. Blow counts have been corrected for sampler diameter.

DEPTH (ft)	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0							
	CA 1	100	3-9-12		SM		Medium Dense to Dense, Brown to Pink, Fine Grained **SILTY SAND**, Dry, with Strongly Cemented Caliche
5	CA 2	100	7-11-14	MC = 6.3% DD = 101.0 pcf LL = NP PL = NP PI = NP Fines = 25.0%			
	CA 3	100	4-7-12				
10	CA 4	78	9-16-16				
15	CA 5	56	8-7-7	MC = 3.6% LL = NP PL = NP PI = NP Fines = 14.8%	SM		15.0
20	CA 6	94	1-1-3				Loose, Pink, Medium Grained **SILTY SAND**, Dry, with Some Gravel size Caliche 20.0
25	CA 7	100	29-50/1"	MC = 4.0% DD = 107.6 pcf LL = NP PL = NP PI = NP Fines = 15.0%	SM		Very Dense, Pink, Fine Grained **SILTY SAND**, Dry, with Some Weakly Cemented Caliche
30	CA 8	0	50/4"				
35							
40							40.0

Borehole terminated at 40.0 ft.

BOREHOLE/TP/WELL - TT CHEVRON COTTON DRAW FRAC POND.GPJ LAB SUMMARY.GDT 7/5/18

APPENDIX B

LABORATORY SUMMARY

TETRA TECH
Tetra Tech Inc.
4000 N. Big Spring, Suite 401
Midland, TX, 79705
Telephone: 432-682-4559
Fax: 432-682-3946

SUMMARY OF LABORATORY RESULTS

CLIENT Chevron

PROJECT NAME Cotton Draw Frac Pond

PROJECT NUMBER 212C-MD-01140

PROJECT LOCATION Lea County, New Mexico

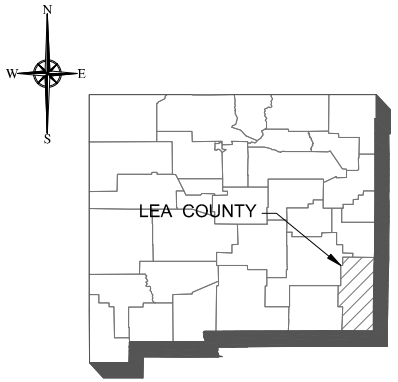
Borehole Identification	Depth	Water Content (%)	Dry Density (pcf)	Atterberg's Limits (LL/PL/PI)	Max Dry Density (pcf)/ OMC(%)	Fines Content (%)	USCS Classi-fication	Swell (%), Swell pressure (psf)	Cc, Cs	Permeability (cm/s)	pH, Resistivity (Ohm-m)	Sulfate, Chloride Content (ppm)	Triaxial Shear Strength c'(psf), phi'	Specific Gravity
B-1	3.5	4.8	90.2	NP		31	SM	-2.1	0.2,0.025					
B-1	18.5	3.1		NP		11	GP-GM							
B-1	28.5	3.0		NP		5	GP-GM							2.66
B-2	3.5	5.0	104.2			21							0,34.5	
B-2	6.0	4.2		NP		13	SM							
B-3	6.5	5.1	101.5	21/17/4		25	SC-SM			3.00E-03				
B-3	18.5	4.2	93.1	NP		15	SM							
B-4	1.5	2.6	93.2	NP		10	SP-SM							
B-4	13.5	3.2		NP		14	SM							
B-5	3.5	6.3	101.0	NP		25	SM	-1.7	0.17,0.021					
B-5	13.5	3.6		NP		15	SM							
B-5	23.5	4.0	107.6	NP		15	SM							
Bulk	5.0			NP	117.8/12.5	19	SM						0,33.7	

LAB SUMMARY-TRIAXIAL CHEVRON COTTON DRAW FRAC POND.GPJ LAB SUMMARY.GDT 7/5/18

Appendix 4 – Recycling Containment Engineering Drawings

CHEVRON N.A. E&P, MCBU
COTTON DRAW
HYDRAULIC FRACTURING
POND 1 AND POND 2
CONSTRUCTION PROJECT

LEA COUNTY, NEW MEXICO



INDEX OF DRAWINGS

GENERAL NOTES

1. ALL TOPOGRAPHIC, UTILITY, AND CONTROL POINT LOCATION INFORMATION IS BASED ON SURVEY INFORMATION DATED **APRIL 10TH, 2018** BY LW SURVEY CO. OF MIDLAND, TEXAS. THE CONTRACTOR HAS THE SOLE RESPONSIBILITY FOR FIELD VERIFICATION.
2. COORDINATE INFORMATION IS BASED ON STATE PLANES COORDINATE **NEW MEXICO EAST ZONE (4726) NAD83**, THE CONTRACTOR SHALL IDENTIFY ANY DISCREPANCIES PRIOR TO PROCEEDING WITH CONSTRUCTION.
3. **LW SURVEY CONTROL POINT LOCATION IS AT**
   NORTHING: 418765.52'
   EASTING: 744330.39'
   ELEVATION: 3463.08'
   TBM #1 LOCATION IS AT
   NORTHING: 418753.61'
   EASTING: 744062.63'
   ELEVATION: 3458.49'
   TBM #2 LOCATION IS AT
   NORTHING: 419579.96'
   EASTING: 744056.58'
   ELEVATION: 3463.55'
   TBM #3 LOCATION IS AT
   NORTHING: 419511.46'
   EASTING: 745674.91'
   ELEVATION: 3466.99'
   TBM #4 LOCATION IS AT
   NORTHING: 418726.63'
   EASTING: 745618.50'
   ELEVATION: 3465.12'
3. THE CONTRACTOR SHALL IDENTIFY AND LOCATE UTILITY LINES, MONITOR WELLS, SURVEY MONUMENTS, AND OTHER NEARBY STRUCTURES PRIOR TO PERFORMING WORK. UTILITIES, MONITOR WELLS, SURVEY MONUMENTS AND OTHER NEARBY STRUCTURES SHALL BE PROTECTED FROM DAMAGE DURING THIS WORK. ANY DAMAGE TO UTILITY LINES, MONITOR WELLS, SURVEY MONUMENTS, AND OTHER NEARBY STRUCTURES DURING THE WORK SHALL BE REPAIRED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER. COSTS ASSOCIATED WITH THESE REPAIRS SHALL INCLUDE THE ACTUAL REPAIR COSTS AND ALL ENGINEERING COSTS REQUIRED BY THE ENGINEER TO COORDINATE AND OBTAIN REGULATORY APPROVAL OF THE REPAIRS IF REQUIRED.
4. THE CONTRACTOR SHALL REFER TO THE COTTON DRAW HYDRAULIC FRESH WATER POND 1 AND POND 2 TECHNICAL SPECIFICATIONS IN ADDITION TO THE DRAWINGS FOR THE CONSTRUCTION.

REVISIONS		
NO.	DATE	DESCRIPTION
A	12/18/2018	ISSUED FOR BID
B	01/22/2019	REVISED DRAWINGS FOR FRESH WATER POND

DESIGNED CM
DRAWN CM
CHECKED NL
DATE 01/22/2019

CONFIDENTIAL NOTICE

Tetra Tech Inc.
Texas Registered Engineering Firm F-3924
4000 N. BIG SPRING, Suite 401
MIDLAND, TEXAS 79705
(432) 682-4559

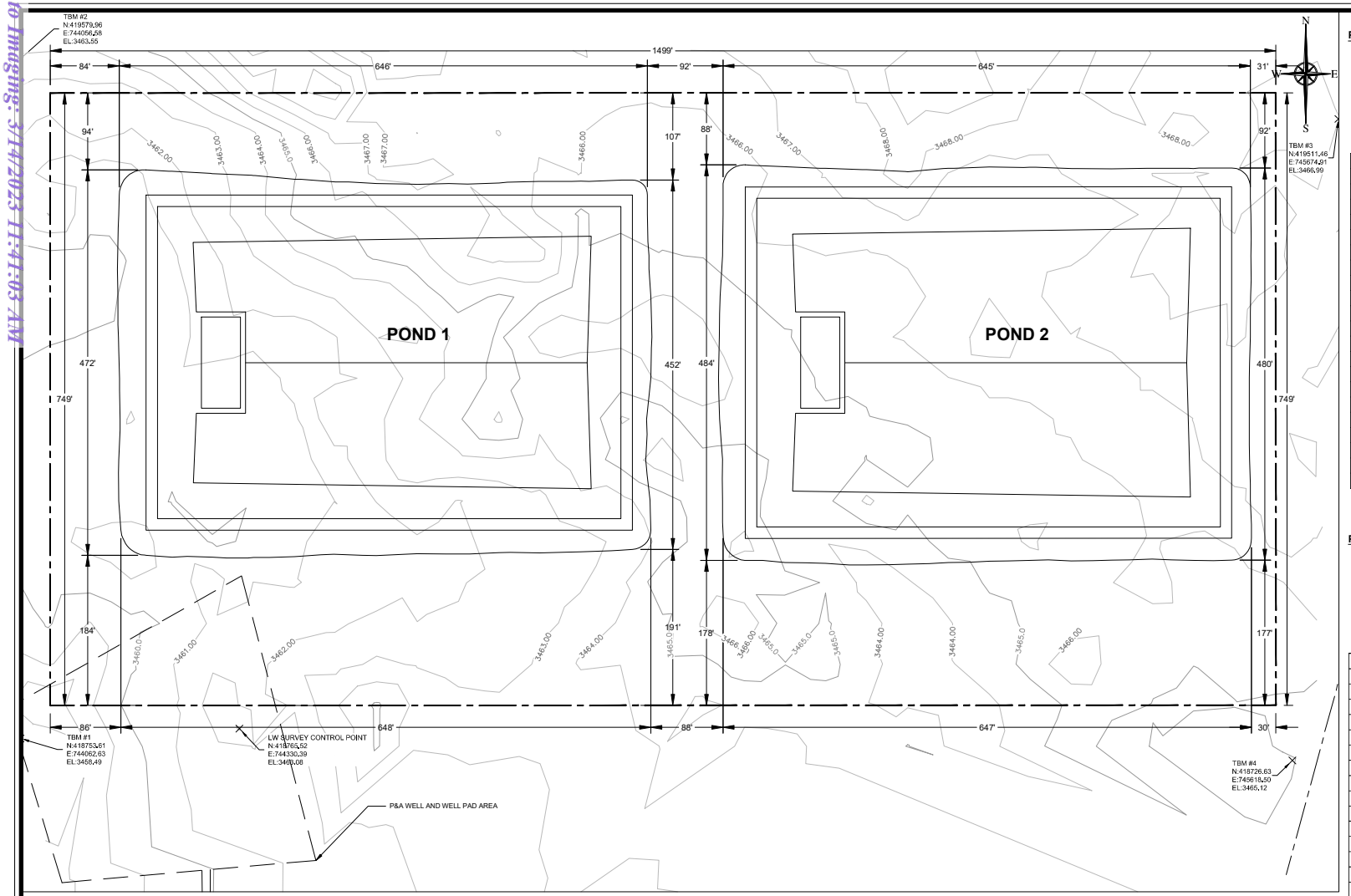
CHEVRON N.A. E&P, MCBU
LEA COUNTY, NEW MEXICO
GPS (WGS84): 32°9'2" N, 103°40'31" W

VERIFY SCALE
BAR IS ONE (1) INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE (1) INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

SCALES:
HORIZONTAL SCALE: NA
VERTICAL SCALE: NA

COVER SHEET
COTTON DRAW HYDRAULIC FRACTURING POND
LEA COUNTY, NEW MEXICO

PROJECT NO. 01140
DRAWING NO. C-1
SHEET NO. 1 OF 14



POND 1 CAPACITY CALCULATIONS WITH 3' OF FREEBOARD (NET)
TOTAL AREA (EL: 3468.5') = 4.59 ACRES
VOLUME = 70,909 yd³
CAPACITY = 340,993 bbls

POND 1 BREACH VOLUME CALCULATION
TOTAL AREA (EL: 3459.9') = 3.93 ACRES
VOLUME = 78,951 yd³
CAPACITY = 379,668 bbls

POND 1 STRAPPING TABLE

ELEVATION (ft)	Increase (yd³)	Cumulative (yd³)	Cumulative (bbls)
3454.0	0	0	0
3455.0	201	201	968
3456.0	279	480	2,308
3457.0	1,098	1,578	7,588
3458.0	3,026	4,604	22,140
3459.0	4,847	9,451	45,450
3460.0	5,640	15,092	72,574
3461.0	5,855	20,947	100,731
3462.0	6,039	26,985	129,770
3463.0	6,225	33,210	159,704
3464.0	6,413	39,623	190,545
3465.0	6,605	46,228	222,308
3466.0	6,799	53,028	255,004
3467.0	6,996	60,024	288,648
3468.0	7,196	67,220	323,253
3468.5	3,689	70,909	340,993
3469.0	3,709	74,618	358,832
3470.0	7,604	82,222	395,397
3471.0	7,812	90,033	432,962
3471.5	4,010	94,043	452,244

POND 2 CAPACITY CALCULATIONS WITH 3' OF FREEBOARD (NET)
TOTAL AREA (EL: 3471.7') = 4.84 ACRES
VOLUME = 74,707 yd³
CAPACITY = 358,964 bbls

POND 2 BREACH VOLUME CALCULATION
TOTAL AREA (EL: 3463.82') = 4.13 ACRES
VOLUME = 79,551 yd³
CAPACITY = 382,553 bbls

POND 2 STRAPPING TABLE

ELEVATION (ft)	Increase (yd³)	Cumulative (yd³)	Cumulative (bbls)
3457.0	0	0	0
3458.0	156	156	752
3459.0	247	404	1,942
3460.0	837	1,241	5,967
3461.0	2,617	3,858	18,552
3462.0	4,718	8,576	41,239
3463.0	5,845	14,420	69,345
3464.0	6,174	20,594	99,036
3465.0	6,363	26,957	129,633
3466.0	6,554	33,511	161,149
3467.0	6,748	40,253	193,598
3468.0	6,944	47,203	226,993
3469.0	7,144	54,347	261,348
3470.0	7,013	61,359	295,072
3471.0	7,551	68,911	331,385
3471.7	5,796	74,707	359,259
3472.0	1,963	76,670	368,697
3473.0	7,969	84,639	407,021
3474.0	8,183	92,822	446,372
3474.7	6,242	99,064	476,389

LEGEND
- EXISTING 5' CONTOUR INTERVAL (FEET, MSL)
- EXISTING 1' CONTOUR INTERVAL
- PROPOSED 5' CONTOUR INTERVAL (FEET, MSL)
- PROPOSED 1' CONTOUR INTERVAL
- PROPOSED POND DESIGN
- PERMIT BOUNDARY (1500' x 750')
- P&A WELL AND WELL PAD AREA

NATHAN A. LANGFORD NEW MEXICO 24399 PROFESSIONAL ENGINEER

REVISIONS		
NO.	DATE	DESCRIPTION
A	12/18/2018	ISSUED FOR BID
B	01/22/2019	REVISED DRAWINGS FOR FRESH WATER POND

DESIGNED CM
DRAWN CM
CHECKED NL
DATE 01/22/2019

Tetra Tech Inc.
Texas Registered Engineering Firm F-3924
4000 N. BIG SPRING, Suite 401
MIDLAND, TEXAS 79705
(432) 682-4559

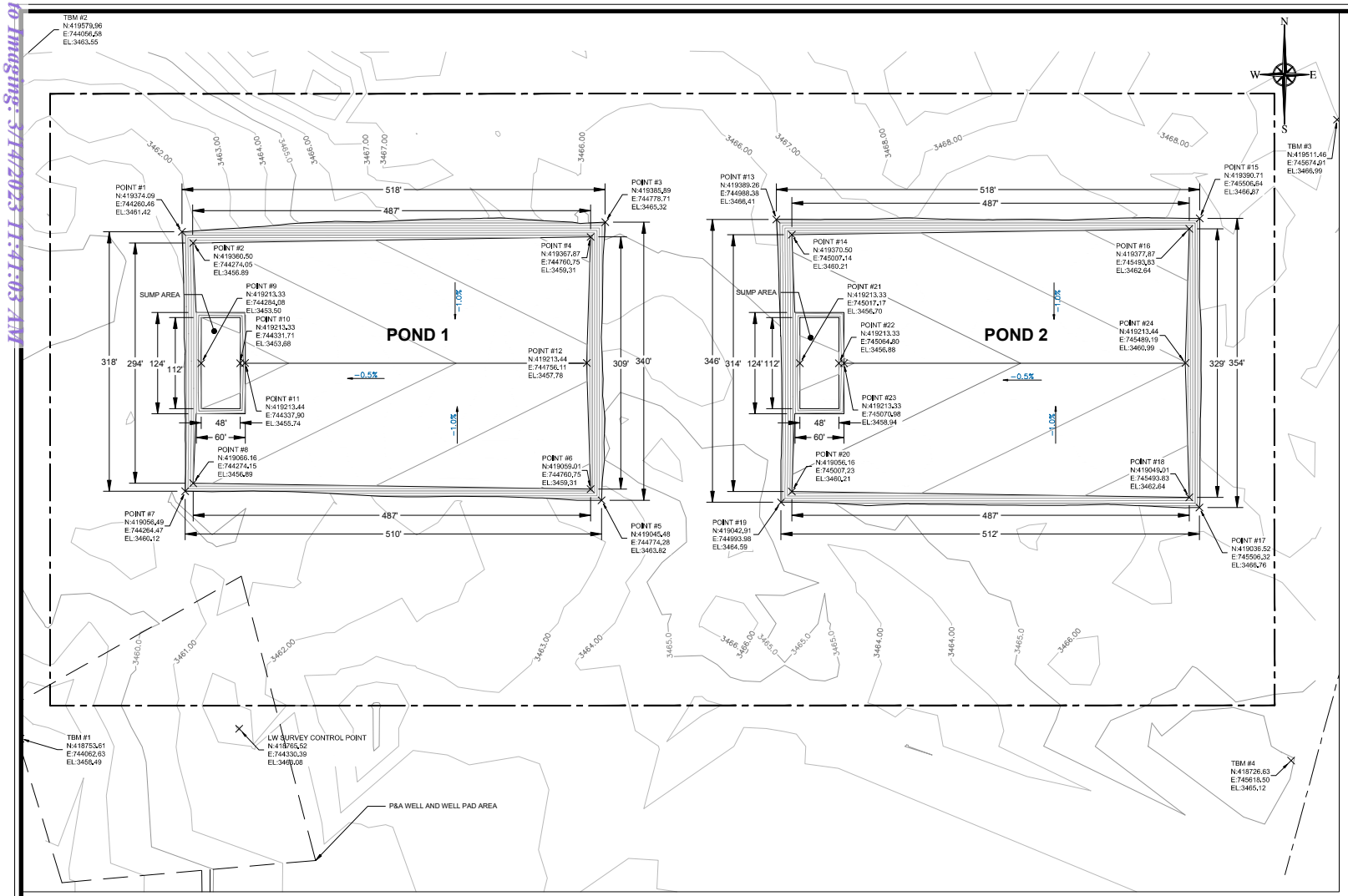
CHEVRON N.A. E&P, MCBU
LEA COUNTY, NEW MEXICO
GPS (WGS84): 32°9'2" N, 103°40'31" W

VERIFY SCALE
BAR IS ONE (1) INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE (1) INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

SCALES:
HORIZONTAL SCALE: NA
VERTICAL SCALE: NA

EXISITING SITE CONDITIONS
COTTON DRAW HYDRAULIC FRACTURING POND
LEA COUNTY, NEW MEXICO

PROJECT NO. 01140
DRAWING NO. C-2
SHEET NO. 2 OF 14



POND 1 EXCAVATION CALCULATION
TOTAL AREA = 3.93 ACRES
EXCAVATION VOLUME = 35,020 yd³

POND 2 EXCAVATION CALCULATION
TOTAL AREA = 4.13 ACRES
EXCAVATION VOLUME = 34,430 yd³

NOTES:
1. GRADE AT TOE 0.25% AWAY FROM EACH POND TOE WHERE EROSION CONTROL IS INSTALLED.
2. SITE SHALL BE CLEARED AT LEAST 10 FEET BEYOND THE CONSTRUCTION LIMIT. THE MAXIMUM LIMIT OF ALLOWABLE CLEARANCE SHALL BE DETERMINED BY CHEVRON.
3. FOR TOTAL SOIL BALANCE CALCULATIONS SHOWN, THE NET DIFFERENCE OF CUT/FILL ESTIMATED (20%) INCLUDES ESTIMATIONS OF THE CLEARING ACTIVITIES AS REQUIRED BY THE SPECIFICATIONS AND EXPECTED CONSTRUCTION LOSSES. MINIMAL LOSSES ARE ANTICIPATED DUE TO SOIL SHRINKAGE

LEGEND
- EXISTING 5' CONTOUR INTERVAL (FEET, MSL)
- EXISTING 1' CONTOUR INTERVAL
- PROPOSED 5' CONTOUR INTERVAL (FEET, MSL)
- PROPOSED 1' CONTOUR INTERVAL
- PROPOSED POND DESIGN
- PERMIT BOUNDARY (1500' x 750')
- P&A WELL AND WELL PAD AREA

NATHAN A. LANGFORD NEW MEXICO 24399 PROFESSIONAL ENGINEER

REVISIONS		
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DATE 01/22/2019

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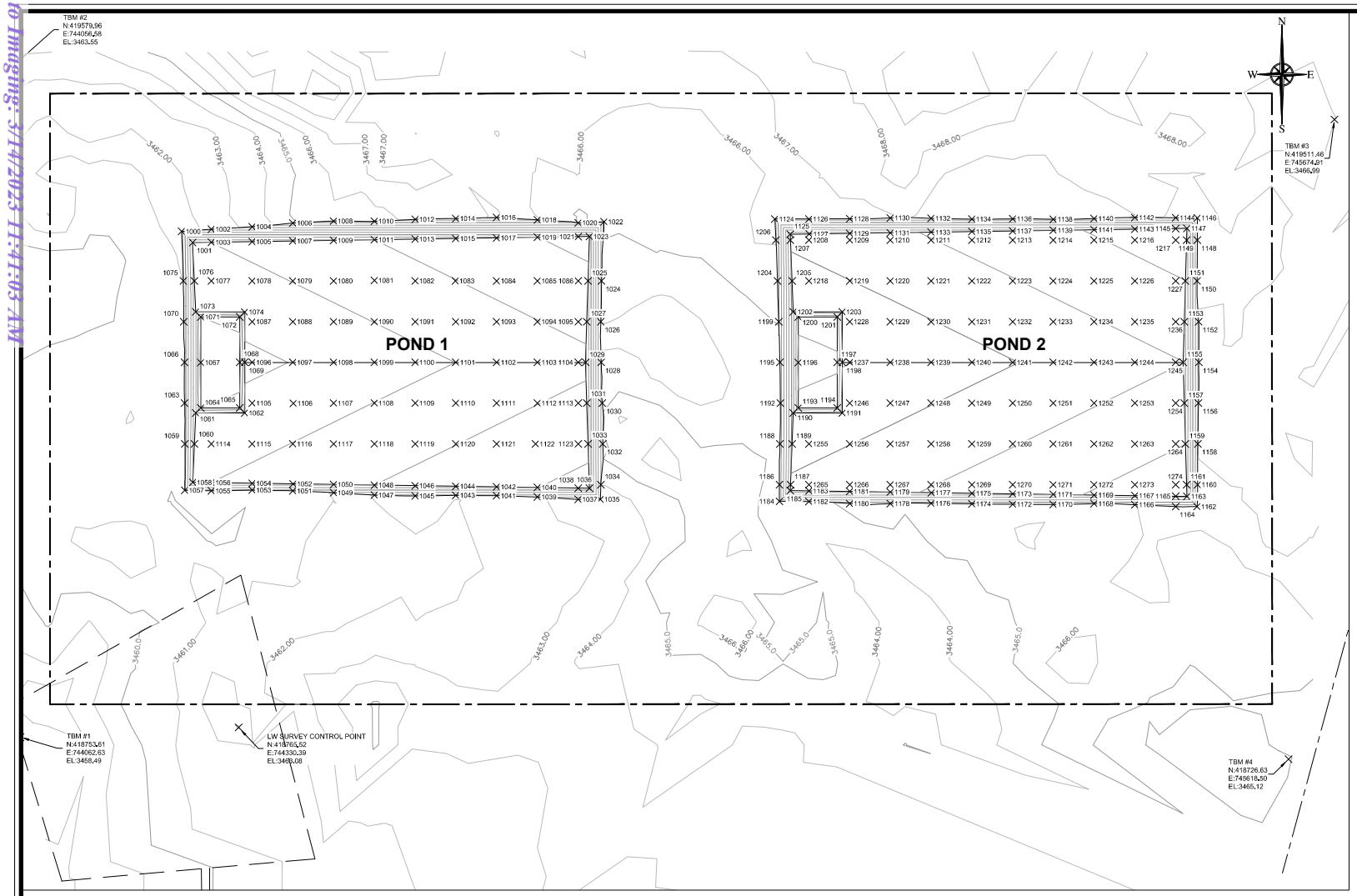
LEA COUNTY, NEW MEXICO
GPS (WGS84): 32°9'2" N, 103°40'31" W

VERIFY SCALE
BAR IS ONE (1) INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE (1) INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

SCALES:
HORIZONTAL SCALE: 1" = 60'
VERTICAL SCALE: NA

POND 1 AND 2 EXCAVATION PLAN
COTTON DRAW HYDRAULIC FRACTURING POND
LEA COUNTY, NEW MEXICO

PROJECT NO. 01140
DRAWING NO. C-3
SHEET NO. 3 OF 14



NOTES:

1. POND 1 BELOW GRADE STAKING PLAN ARE FROM 1000 THROUGH 1123. REFERENCE ASCII FILE - POND 1 BELOW GRADE STAKING PLAN.TXT
2. POND 2 BELOW GRADE STAKING PLAN ARE FROM 1124 THROUGH 1274. REFERENCE ASCII FILE - POND 2 BELOW GRADE STAKING PLAN.TXT
3. STAKING POINT FILES ARE COMMA DELINEATED WITH CORRESPONDING POINT NUMBER, EASTING, NORTHING, AND ELEVATION (PENZ).

LEGEND

- EXISTING 5' CONTOUR INTERVAL (FEET, MSL)
- EXISTING 1' CONTOUR INTERVAL
- PROPOSED 5' CONTOUR INTERVAL (FEET, MSL)
- PROPOSED 1' CONTOUR INTERVAL
- PROPOSED POND DESIGN
- PERMIT BOUNDARY (1500' x 750')
- P&A WELL AND WELL PAD AREA

NATHAN A. LANGFORD NEW MEXICO 24399 PROFESSIONAL ENGINEER

REVISIONS		
NO.	DATE	DESCRIPTION
A	12/18/2018	ISSUED FOR BID
B	01/22/2019	REVISED DRAWINGS FOR FRESH WATER POND

DESIGNED CM
DRAWN CM
CHECKED NL
DATE 01/22/2019

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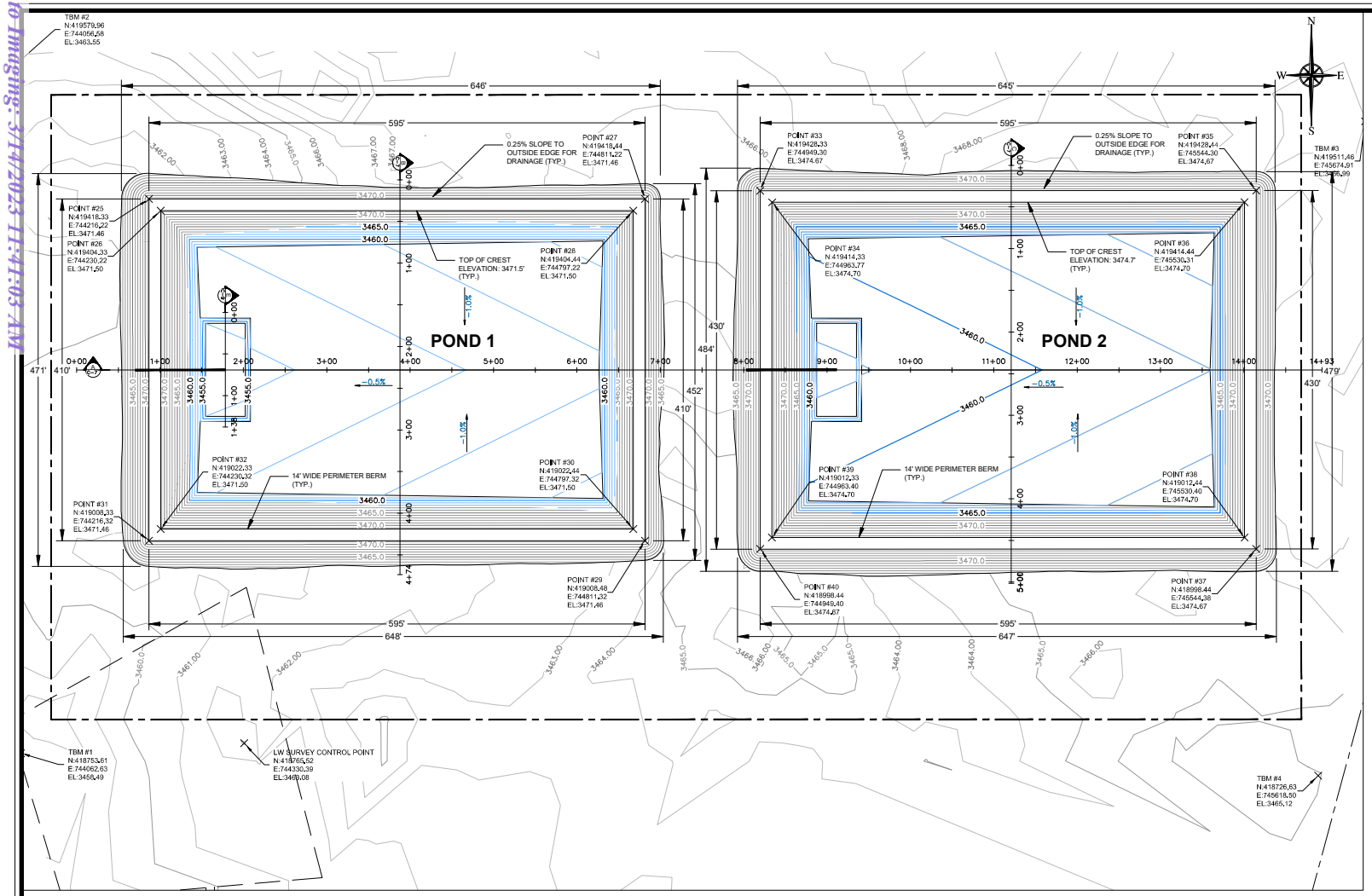
CHEVRON N.A. E&P, MCBU
LEA COUNTY, NEW MEXICO
GPS (WGS84): 32°9'2" N, 103°40'31" W

VERIFY SCALE
BAR IS ONE (1) INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE (1) INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

SCALES:
HORIZONTAL SCALE: 1" = 60'
VERTICAL SCALE: NA

POND 1 AND 2
BELOW GRADE STAKING PLAN
COTTON DRAW HYDRAULIC FRACTURING POND
LEA COUNTY, NEW MEXICO

PROJECT NO. 01140
DRAWING NO. C-4
SHEET NO. 4 OF 14



POND 1 CAPACITY CALCULATIONS (GROSS)
TOTAL AREA (EL: 3471.5') = 4.97 ACRES
VOLUME = 94,043 yd³
CAPACITY = 452,244 bbls

POND 1 CAPACITY CALCULATIONS (NET)
TOTAL AREA (EL: 3468.5') = 4.59 ACRES
VOLUME = 70,909 yd³
CAPACITY = 340,993 bbls

POND 1 BREACH VOLUME CALCULATION
TOTAL AREA (EL: 3459.9') = 3.93 ACRES
VOLUME = 78,951 yd³
CAPACITY = 379,668 bbls

POND 1 SOIL BALANCE CALCULATIONS
TOTAL AREA(FOOTPRINT) = 6.82 ACRES
FILL VOLUME (x1.25) = 31,333 yd³
EXCAVATION VOLUME = 35,020 yd³
EXCESS VOLUME = 3,687 yd³

POND 2 CAPACITY CALCULATIONS (GROSS)
TOTAL AREA (EL: 3474.7') = 5.23 ACRES
VOLUME = 99,064 yd³
CAPACITY = 476,389 bbls

POND 2 CAPACITY CALCULATIONS (NET)
TOTAL AREA (EL: 3471.7') = 4.84 ACRES
VOLUME = 74,707 yd³
CAPACITY = 358,954 bbls

POND 2 BREACH VOLUME CALCULATION
TOTAL AREA (EL: 3463.8') = 4.13 ACRES
VOLUME = 79,551 yd³
CAPACITY = 382,553 bbls

POND 2 SOIL BALANCE CALCULATIONS
TOTAL AREA(FOOTPRINT) = 7.14 ACRES
FILL VOLUME (x1.25) = 31,908 yd³
EXCAVATION VOLUME = 34,430 yd³
EXCESS VOLUME = 2,521 yd³

NOTES:
1. GRADE AT TOE 0.25% AWAY FROM EACH POND TOE WHERE EROSION CONTROL IS INSTALLED.
2. SITE SHALL BE CLEARED AT LEAST 10 FEET BEYOND THE CONSTRUCTION LIMIT. THE MAXIMUM LIMIT OF ALLOWABLE CLEARANCE SHALL BE DETERMINED BY CHEVRON.
3. FOR TOTAL SOIL BALANCE CALCULATIONS SHOWN, THE NET DIFFERENCE OF CUT/FILL ESTIMATED (20%) INCLUDES ESTIMATIONS OF THE CLEARING ACTIVITIES AS REQUIRED BY THE SPECIFICATIONS AND EXPECTED CONSTRUCTION LOSSES. MINIMAL LOSSES ARE ANTICIPATED DUE TO SOIL SHRINKAGE.

LEGEND
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- EXISTING 1' CONTOUR INTERVAL
- PROPOSED 5' CONTOUR INTERVAL (FEET, MSL)
- PROPOSED 1' CONTOUR INTERVAL
- EXCAVATION 5' CONTOUR INTERVAL (FEET, MSL)
- EXCAVATION 1' CONTOUR INTERVAL (FEET, MSL)
- PROPOSED POND DESIGN
- PERMIT BOUNDARY (1500' x 750')
- P&A WELL AND WELL PAD AREA

NATHAN A. LANGFORD NEW MEXICO 24399 PROFESSIONAL ENGINEER

REVISIONS		
NO.	DATE	DESCRIPTION
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DESIGNED CM
DRAWN CM
CHECKED NL
DATE 01/22/2019

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LEA COUNTY, NEW MEXICO
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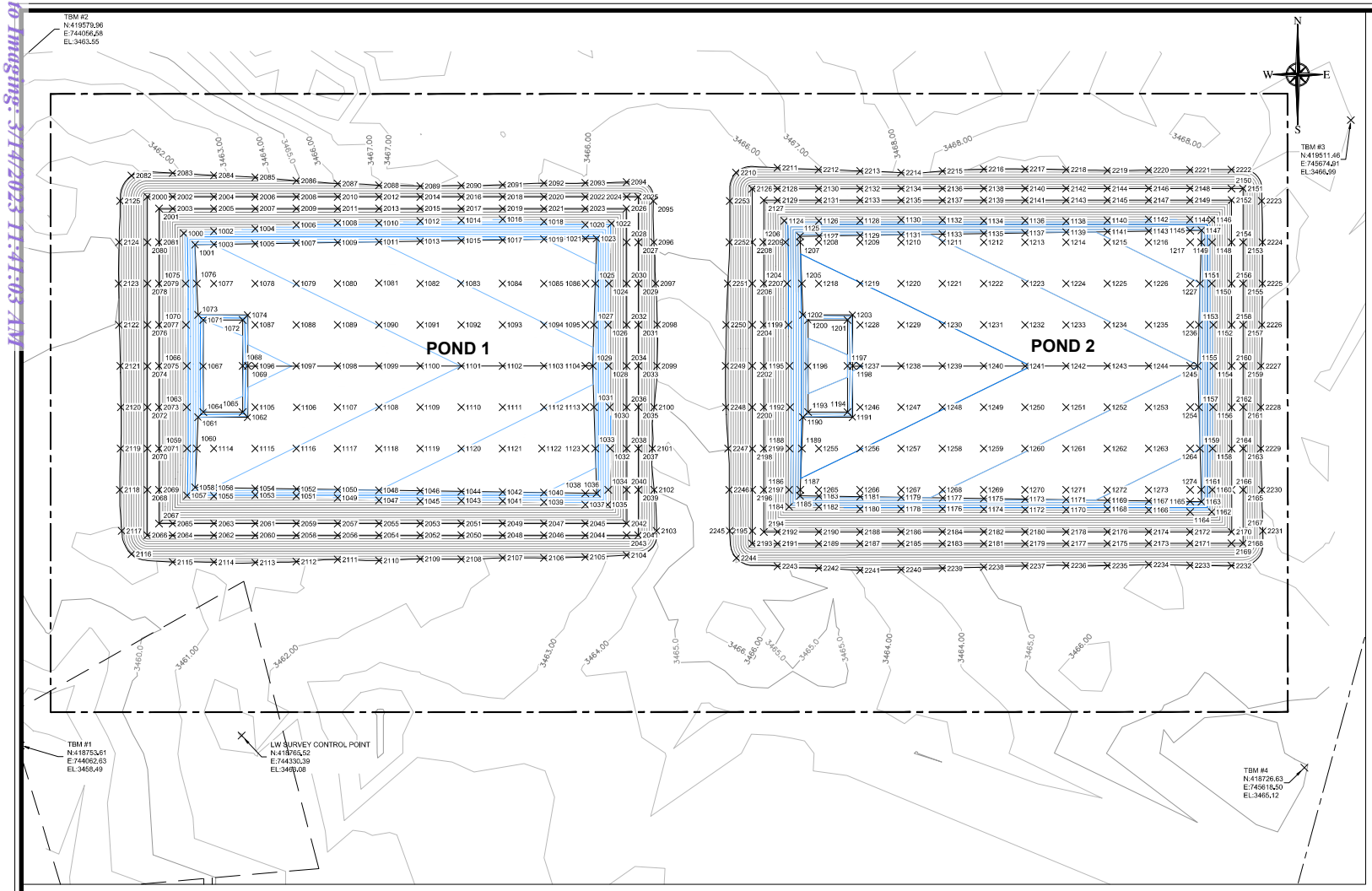
VERIFY SCALE
BAR IS ONE (1) INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE (1) INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

SCALES:
HORIZONTAL SCALE: 1" = 60'
VERTICAL SCALE: NA

POND 1 AND 2
COMPLETION PLAN
COTTON DRAW HYDRAULIC FRACTURING POND
LEA COUNTY, NEW MEXICO

PROJECT NO. 01140
DRAWING NO. C-5
SHEET NO. 5 OF 14



NOTES:

1. POND 1 ABOVE GRADE STAKING PLAN ARE FROM 2000 THROUGH 2125. REFERENCE ASCII FILE - POND 1 ABOVE GRADE STAKING PLAN.TXT
2. POND 2 ABOVE GRADE STAKING PLAN ARE FROM 2126 THROUGH 2253. REFERENCE ASCII FILE - POND 2 ABOVE GRADE STAKING PLAN.TXT
3. STAKING POINT FILES ARE COMMA DELINEATED WITH CORRESPONDING POINT NUMBER, EASTING, NORTHING, AND ELEVATION (PENZ).

LEGEND

- EXISTING 5' CONTOUR INTERVAL (FEET, MSL)
- EXISTING 1' CONTOUR INTERVAL
- PROPOSED 5' CONTOUR INTERVAL (FEET, MSL)
- PROPOSED 1' CONTOUR INTERVAL
- EXCAVATION 5' CONTOUR INTERVAL (FEET, MSL)
- EXCAVATION 1' CONTOUR INTERVAL (FEET, MSL)
- PROPOSED POND DESIGN
- PERMIT BOUNDARY (1500' x 750')
- P&A WELL AND WELL PAD AREA

NATHAN A. LANGFORD NEW MEXICO 24399 PROFESSIONAL ENGINEER

REVISIONS		
NO.	DATE	DESCRIPTION
A	12/18/2018	ISSUED FOR BID
B	01/22/2019	REVISED DRAWINGS FOR FRESH WATER POND

DESIGNED CM
DRAWN CM
CHECKED NL
DATE 01/22/2019

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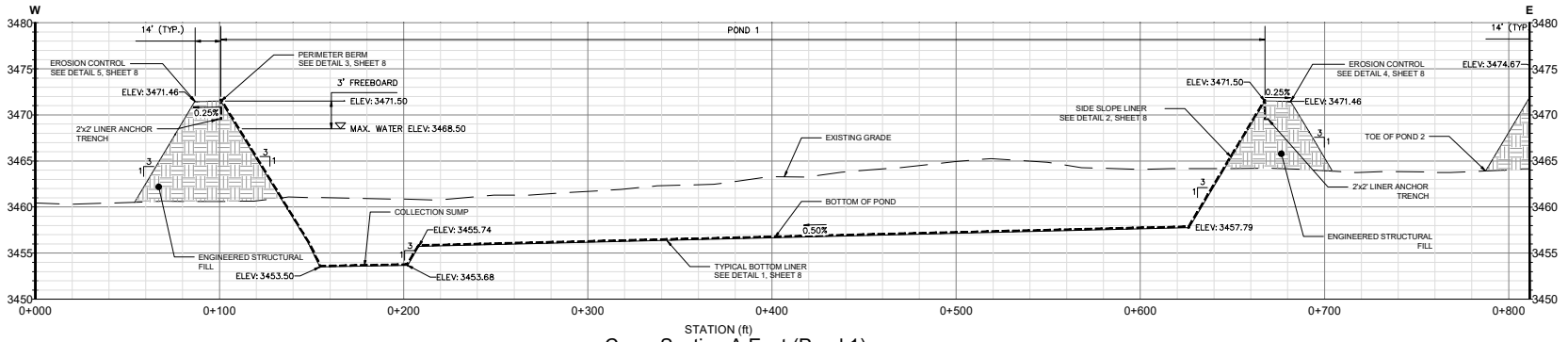
LEA COUNTY, NEW MEXICO
GPS (WGS84): 32°9'2" N, 103°40'31" W

VERIFY SCALE
BAR IS ONE (1) INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE (1) INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

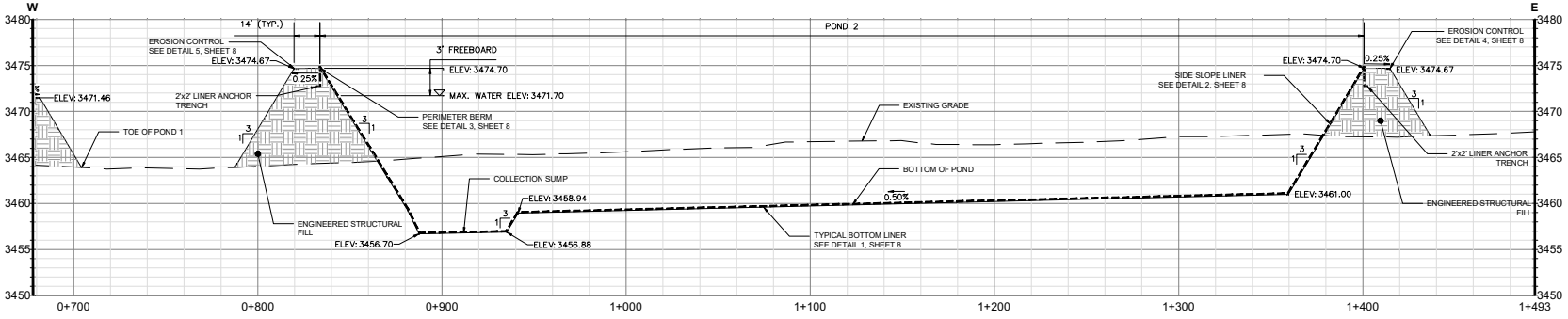
SCALES:
HORIZONTAL SCALE: 1" = 60'
VERTICAL SCALE: NA

POND 1 AND POND 2
ABOVE GRADE STAKING PLAN
COTTON DRAW HYDRAULIC FRACTURING POND
LEA COUNTY, NEW MEXICO

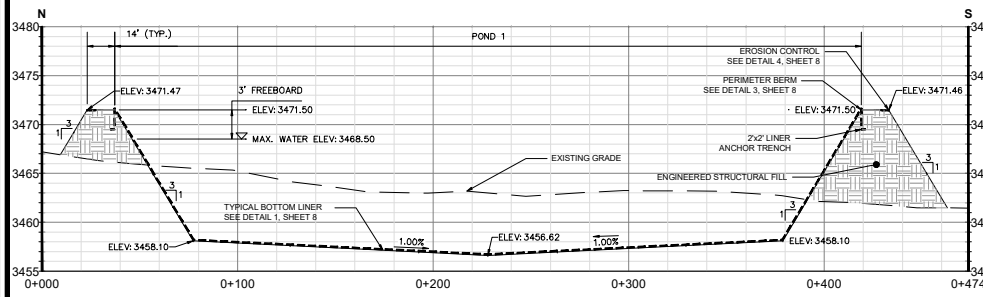
PROJECT NO. 01140
DRAWING NO. C-6
SHEET NO. 6 OF 14



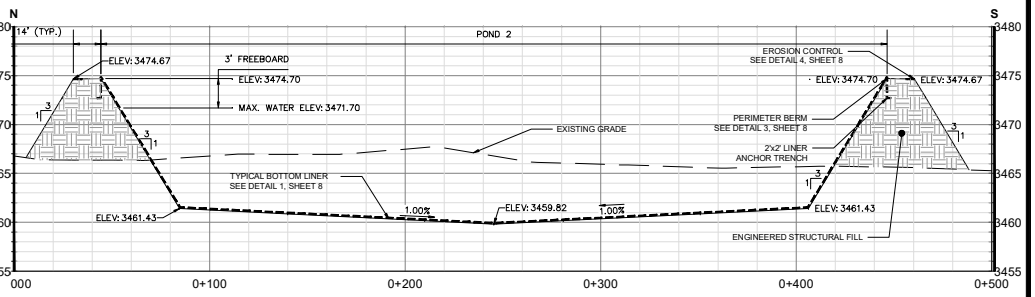
Cross Section A East (Pond 1)



Cross Section A West (Pond 2)



Cross Section B



Cross Section C

NATHAN A. LANGFORD NEW MEXICO 24399 PROFESSIONAL ENGINEER

REVISIONS		
NO.	DATE	DESCRIPTION
A	12/18/2018	ISSUED FOR BID
B	01/22/2019	REVISED DRAWINGS FOR FRESH WATER POND

DESIGNED	CM
DRAWN	CM
CHECKED	NL
DATE	01/22/2019

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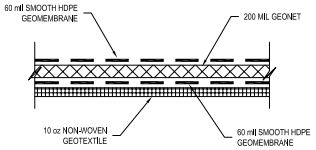
CHEVRON N.A. E&P, MCBU
LEA COUNTY, NEW MEXICO
GPS (WGS84): 32°9'2" N, 103°40'31" W

VERIFY SCALE
BAR IS ONE (1) INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE (1) INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

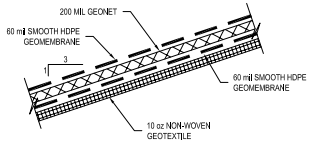
SCALES:
HORIZONTAL SCALE: 1" = 60'
VERTICAL SCALE: 1" = 12'

POND 1 AND POND 2
CROSS-SECTIONS
COTTON DRAW HYDRAULIC FRACTURING POND
LEA COUNTY, NEW MEXICO

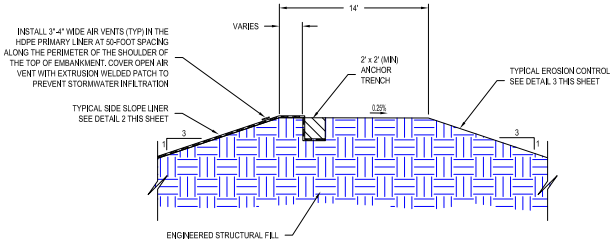
PROJECT NO. 01140
DRAWING NO. C-7
SHEET NO. 7 OF 14



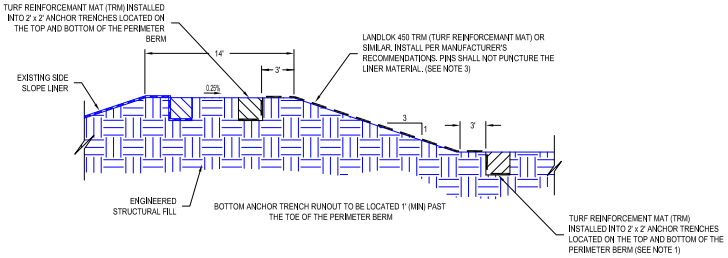
1 TYPICAL BOTTOM LINER
NTS



2 TYPICAL SIDE SLOPE LINER
NTS



3 PERIMETER BERM
NTS



4 EROSION CONTROL EXTERIOR PERIMETER BERM
NTS

NOTES:

1. ANCHOR TRENCHES WILL BE INSTALLED PER THE DRAWINGS AND AS RECOMMENDED BY THE MANUFACTURER.
2. EROSION CONTROL IN DETAIL 4 ARE RECOMMENDED TO MINIMIZE EROSION AND WILL NOT PREVENT EROSION FOR ALL WEATHER EVENTS.
3. THE CONTRACTOR SHALL REFER TO THE TECHNICAL SPECIFICATIONS FOR THE PROJECT PROVIDED BY CHEVRON FOR CONSTRUCTION AND ALL GEOSYNTHETICS INSTALLATIONS.
4. DURING CONSTRUCTION AND OPERATIONAL PERIODS WHEN THE PONDS ARE NOT IN USE, BALLASTS, SUCH AS SANDBAGS OR SIMILAR, SHOULD BE PLACED ON TOP OF ALL LINERS TO MINIMIZE POTENTIAL FOR LINER SYSTEM PULLOUT. REFER TO CHEVRON SPECIFICATIONS AND REQUIREMENTS.

REVISIONS		
NO	DATE	DESCRIPTION
1	02/16/23	DRAFT FOR REVIEW

DESIGNED NL
DRAWN DKK
CHECKED NL
DATE 02/17/23

Tetra Tech Inc.
Texas Registered Engineering Firm F-3924
901 W. Wall St., Suite 100
MIDLAND, TEXAS 79705
(432) 682-4559

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LEA COUNTY, NEW MEXICO
GPS (WGS84): 32°9'2"N, 103°40'31"W

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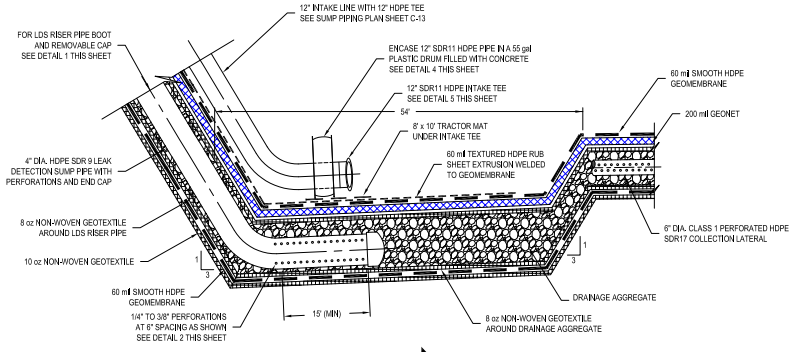
BAR IS ONE (1) INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE (1) INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

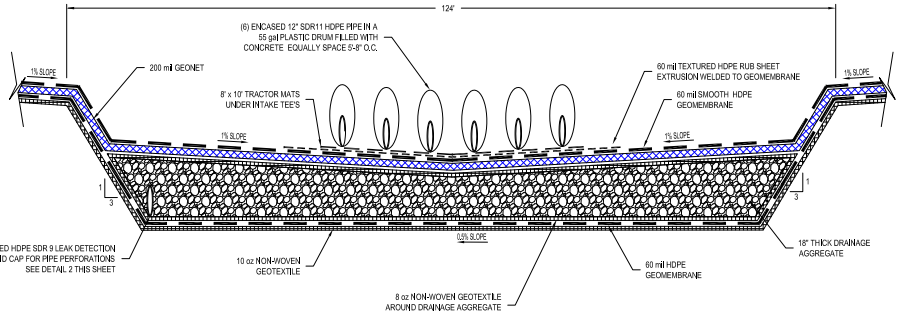
SCALES:
HORIZONTAL SCALE: 1" = 20'
VERTICAL SCALE: NA

TYPICAL LINER AND EROSION CONTROL DETAILS
COTTON DRAW HYDRAULIC FRACTURING POND
LEA COUNTY, NEW MEXICO

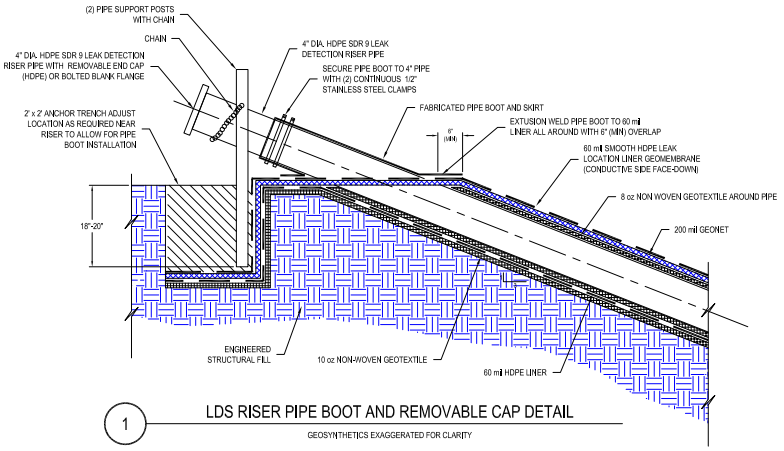
PROJECT NO. 01140
DRAWING NO. C-8
SHEET NO. 8 OF 14



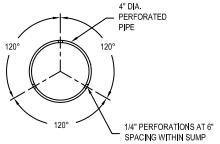
Section D
VERTICAL SCALE
EXAGGERATED 5X



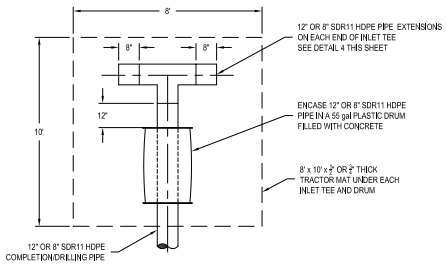
Section E
VERTICAL SCALE
EXAGGERATED 5X

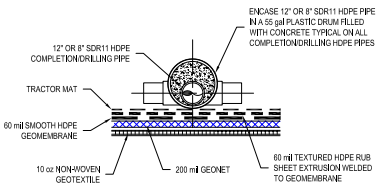


1 LDS RISER PIPE BOOT AND REMOVABLE CAP DETAIL
GEOSYNTHETICS EXAGGERATED FOR CLARITY

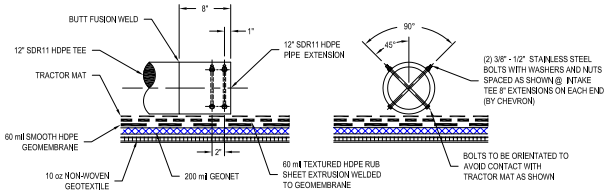


2 SUMP PIPE DETAIL
NTS





3 TYPICAL INLET TEE & DRUM
NTS



4 TYPICAL @ INLET TEE END
NTS

NOTES:

1. 4" LEAK DETECTION RISER PIPE WILL BE PERFORATED WITHIN SUMP. PERFORATIONS WILL BE 1/4" TO 3/8" DIAMETER HOLES AT 6" SPACING INTERVALS. PERFORATIONS WILL BE AT 120° AROUND THE CIRCUMFERENCE OF THE LEAK DETECTION SYSTEM RISER PIPE REFERENCE DETAIL 2 THIS SHEET.
2. ANCHOR TRENCH WILL BE INSTALLED PER THE DRAWINGS AND AS RECOMMENDED BY THE MANUFACTURER.
3. THE CONTRACTOR SHALL REFER TO THE TECHNICAL SPECIFICATIONS FOR THE PROJECT PROVIDED BY CHEVRON FOR CONSTRUCTION AND ALL GEOSYNTHETICS INSTALLATIONS .
4. GEOSYNTHETICS HAVE BEEN EXAGGERATED FOR CLARITY.
5. ALL GEOSYNTHETICS, PIPING, INLET TEE AND DRUM IS SPECIFIED AND INSTALLED BY CHEVRON.

REVISIONS		
NO.	DATE	DESCRIPTION
1	02/17/23	FOR DRAFT REVIEW

DESIGNED NL
DRAWN DKK
CHECKED NAL
DATE 02/17/23

Tetra Tech Inc.
Texas Registered Engineering Firm F-3924
901 W. Wall St., Suite 100
MIDLAND, TEXAS 79705
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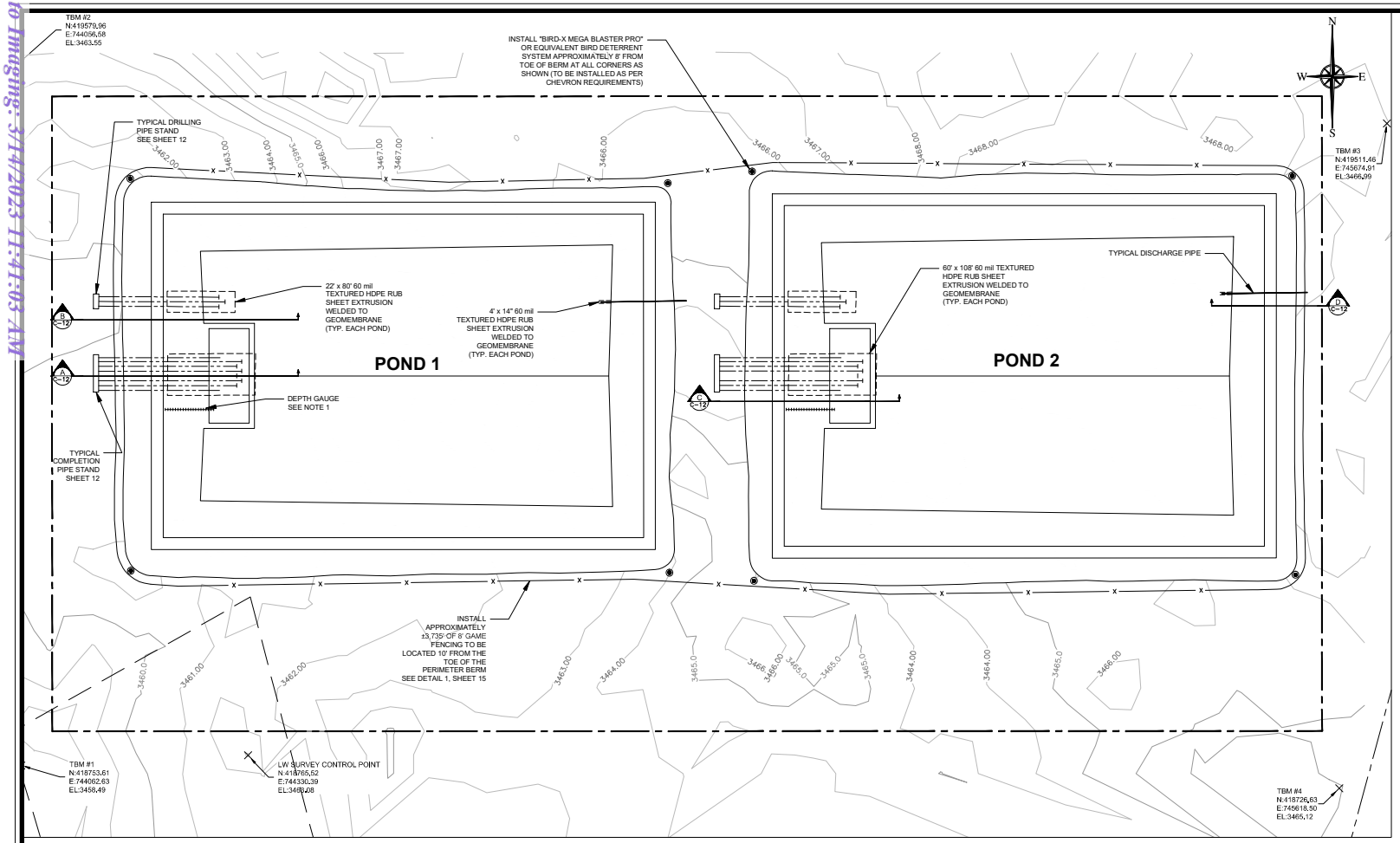
VERIFY SCALE
BAR IS ONE (1) INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE (1) INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

SCALES:
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: NA

SUMP CROSS-SECTIONS AND DETAILS
COTTON DRAW HYDRAULIC FRACTURING POND
LEA COUNTY, NEW MEXICO

PROJECT NO. 01140
DRAWING NO. C-9
SHEET NO. 9 OF 14



NOTES:

1. UPON COMPLETION OF LINER INSTALLATION. LINER CONTRACTOR SHALL EXTRUSION WELD A GAUGE (AS NUMBERS) TO INDICATED DEPTH FROM THE TOP OF THE POND TO THE SUMP IN 1' INCREMENTS. MARKERS SHALL BE AT LEAST 2' IN HEIGHT AND INSTALLED ON THE SUMP END OF EACH POND. ONE MARKER SHALL BE INSTALLED TO INDICATED A 3' FREEBOARD LEVEL.
2. THE CONTRACTOR SHALL REFER TO THE TECHNICAL SPECIFICATIONS FOR THE SAND DUNES HYDRAULIC FRESH WATER POND 1 AND POND 2 CONSTRUCTION IN ADDITION TO THE DRAWINGS FOR GEOSYNTHETIC SPECIFICATIONS.

LEGEND

- EXISTING 5' CONTOUR INTERVAL (FEET, MSL)
- EXISTING 1' CONTOUR INTERVAL
- PROPOSED POND DESIGN
- PERMIT BOUNDARY (1500' x 750')
- P&A WELL AND WELL PAD AREA
- PROPOSED FENCE
- 3' ACCESS GATE
- 20' WIDE ACCESS GATE
- BIRD DETERRENT SYSTEM

REVISIONS		
NO.	DATE	DESCRIPTION
A	12/18/2018	ISSUED FOR BID
B	01/22/2019	REVISED DRAWINGS FOR FRESH WATER POND

DESIGNED CM
DRAWN CM
CHECKED NL
DATE 01/22/2019

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(432) 682-4559

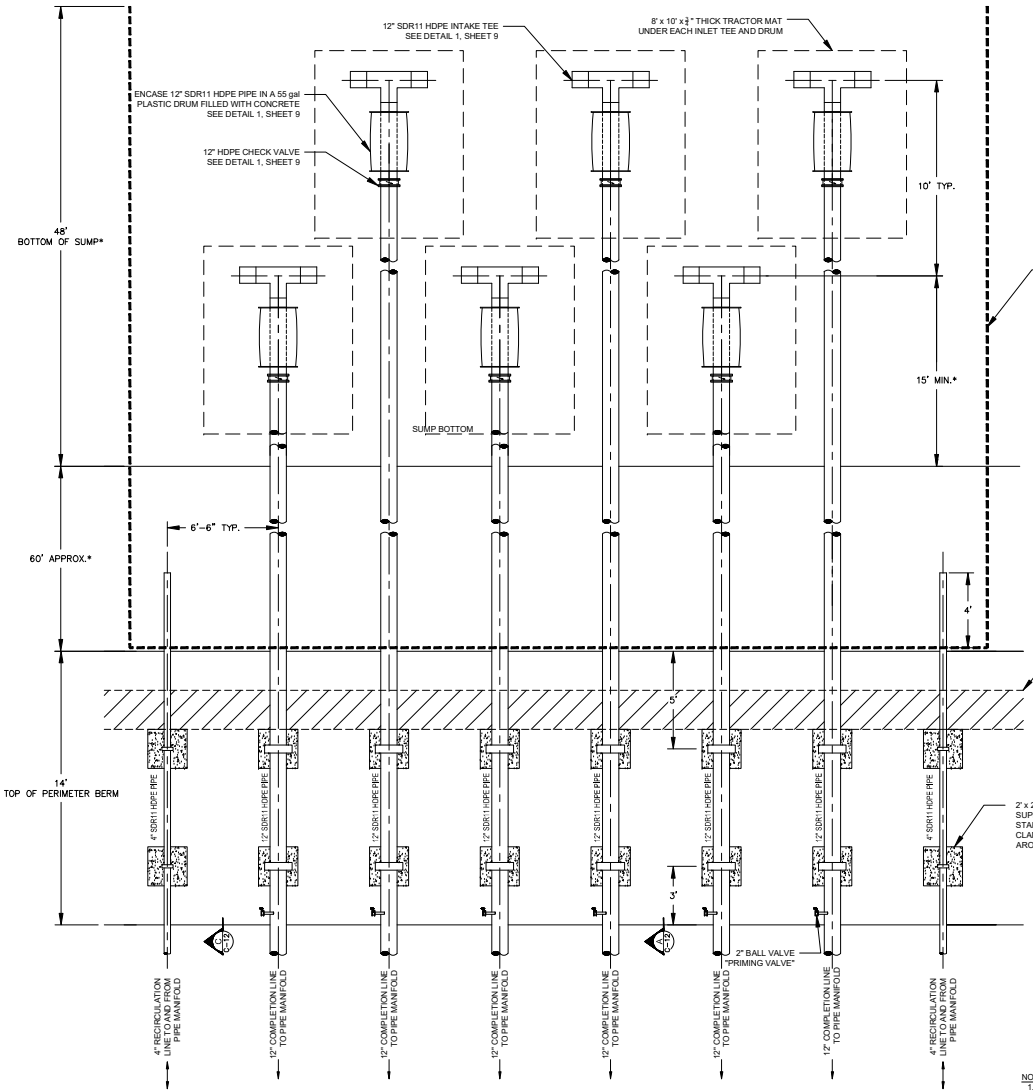
CHEVRON N.A. E&P, MCBU
LEA COUNTY, NEW MEXICO
GPS (WGS84): 32°9'2" N, 103°40'31" W

VERIFY SCALE
BAR IS ONE (1) INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE (1) INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

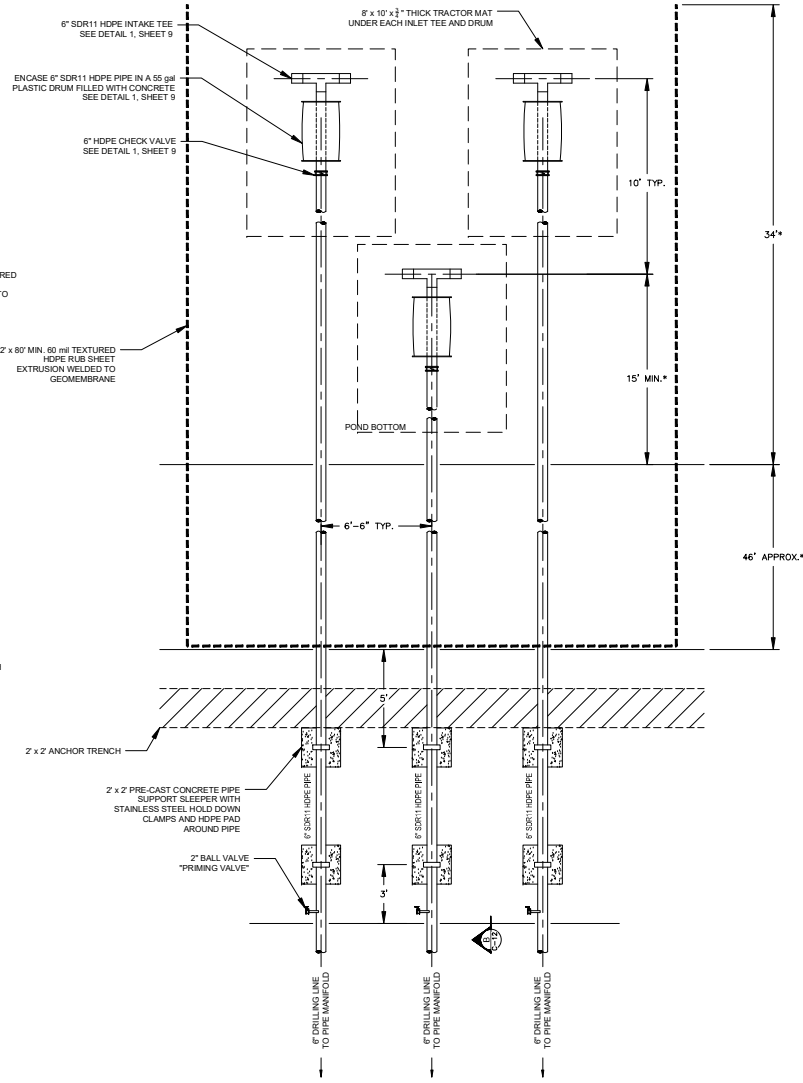
SCALES:
HORIZONTAL SCALE: NA
VERTICAL SCALE: NA

SITE PIPING PLAN
COTTON DRAW HYDRAULIC FRACTURING POND
LEA COUNTY, NEW MEXICO

PROJECT NO. 01140
DRAWING NO. C-10
SHEET NO. 10 OF 14



DETAIL 1 - SUMP PIPING PLAN VIEW
COMPLETION



DETAIL 2 - SUMP PIPING PLAN VIEW DRILLING

NOTES:
1. INTERNAL PIPE PRESSURE SHALL NOT EXCEED 150 PSI.
2. DIMENSIONS SHOWN WITH AN ASTERISK (*) ARE NOT TO SCALE.
3. RUB SHEET DIMENSIONS ARE MINIMUM AND APPROXIMATE. RUB SHEET DIMENSIONS MAY BE INCREASED AS NEEDED FOR DIRECTED BY CHEVRON FOR PLACEMENT BENEATH ALL PIPING IN THE PONDS.
4. ALL PIPE STAND HEIGHT ABOVE GRADE AND SPACING BETWEEN THE STRUCTURAL CHANNELS TO BE DETERMINED IN THE FIELD DEPENDING ON THE EQUIPMENT SPACING ON THE PIPE STAND (TO BE DETERMINED BY CHEVRON)
5. PIPING, PUMPS, VALVES, AND FITTINGS DESIGNED AND INSTALLED BY CHEVRON.
6. INLET TEE AND DRUM DESIGNED AND INSTALLED BY CHEVRON.

REVISIONS		
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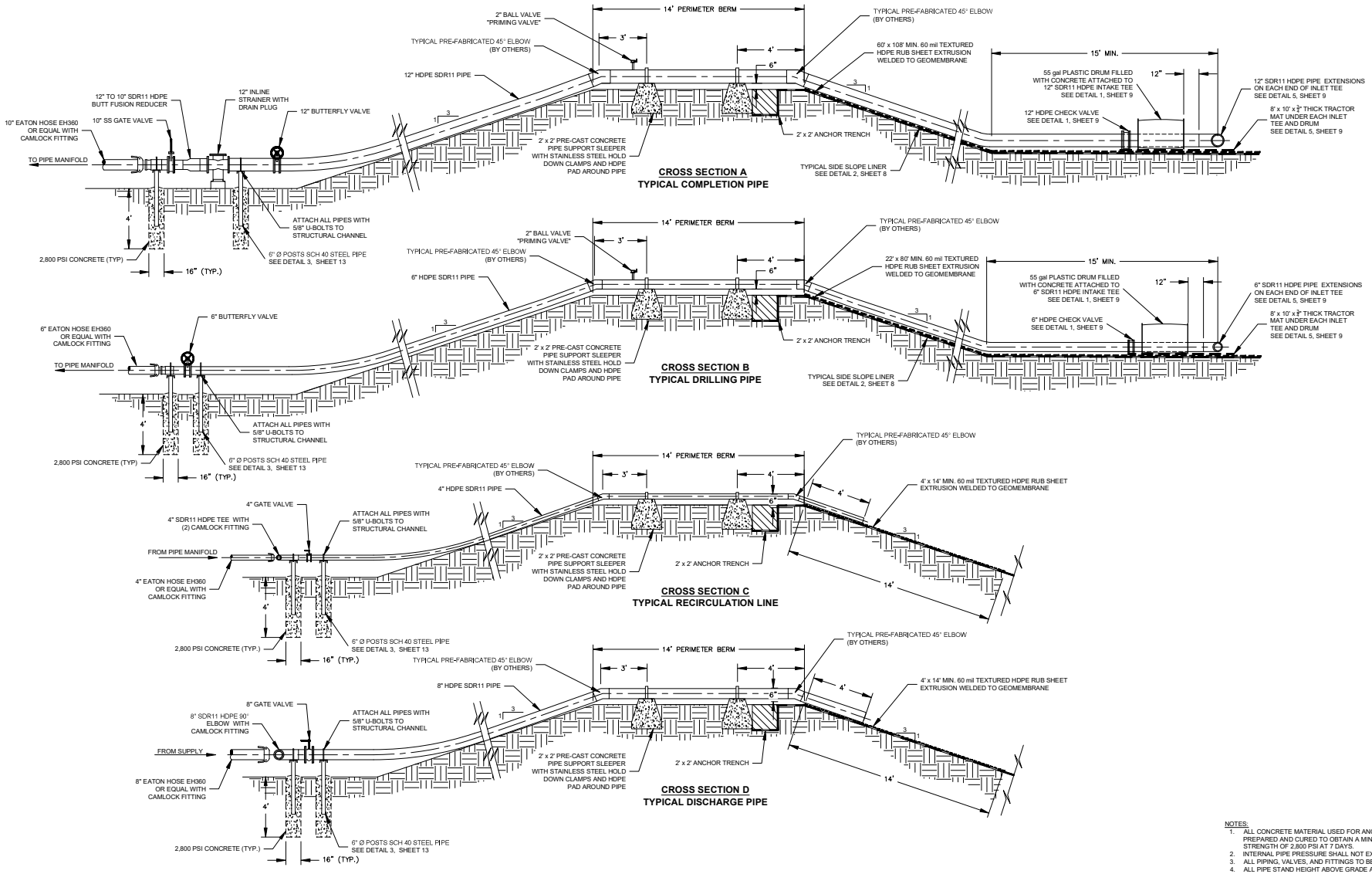
SCALES:
HORIZONTAL SCALE: AS SHOWN
VERTICAL SCALE: AS SHOWN

TYPICAL SUMP PIPING PLAN
COTTON DRAW HYDRAULIC FRACTURING POND
LEA COUNTY, NEW MEXICO

PROJECT NO. 01140
DRAWING NO. C-11
SHEET NO. 11 OF 14



NOTES:
1. ALL CONCRETE MATERIAL USED FOR ANCHOR OR BALLAST SHALL BE PREPARED AND CURED TO OBTAIN A MINIMUM COMPRESSIVE STRENGTH OF 2,800 PSI AT 7 DAYS.
2. INTERNAL PIPE PRESSURE SHALL NOT EXCEED 150 PSI.
3. ALL PIPING, VALVES, AND FITTINGS TO BE SPECIFIED BY CHEVRON.
4. ALL PIPE STAND HEIGHT ABOVE GRADE AND SPACING BETWEEN STRUCTURAL CHANNELS TO BE DETERMINED IN THE FIELD DEPENDING ON THE EQUIPMENT SPACING ON THE PIPE STAND (TO BE DETERMINED BY CHEVRON)
5. INLET TEE AND DRUM DESIGNED AND INSTALLED BY CHEVRON

REVISIONS		
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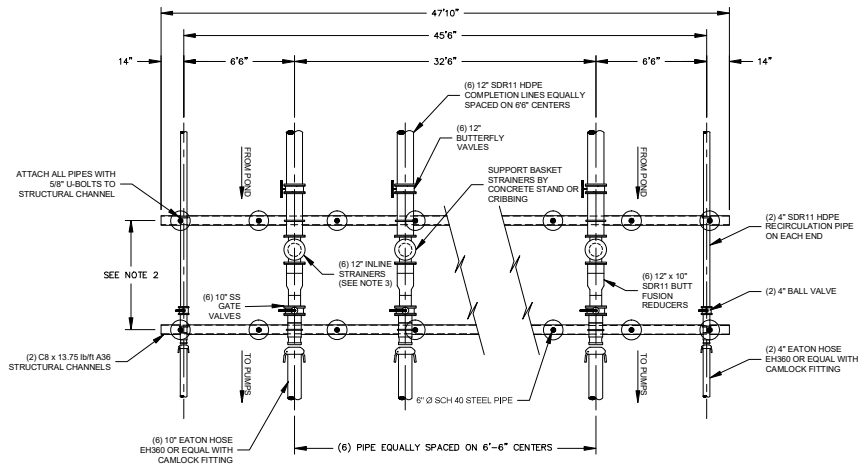
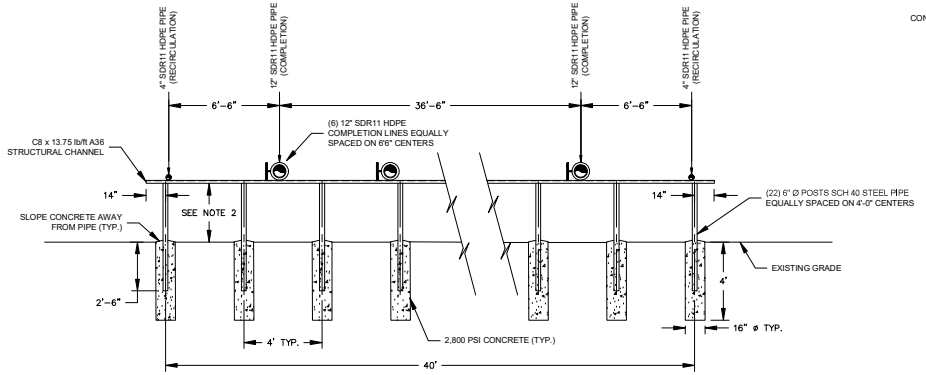
SCALES:
HORIZONTAL SCALE: NTS
VERTICAL SCALE: NTS

TYPICAL PIPE SECTIONS
COTTON DRAW HYDRAULIC FRACTURING POND
LEA COUNTY, NEW MEXICO

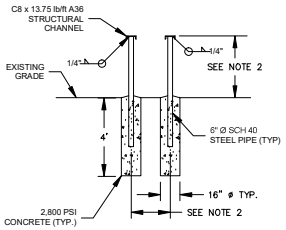
PROJECT NO. 01140
DRAWING NO. C-12
SHEET NO. 12 OF 14



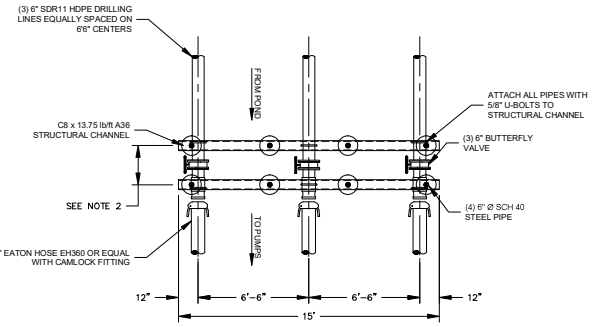
DETAIL 1 - PIPE STAND PLAN VIEW COMPLETION



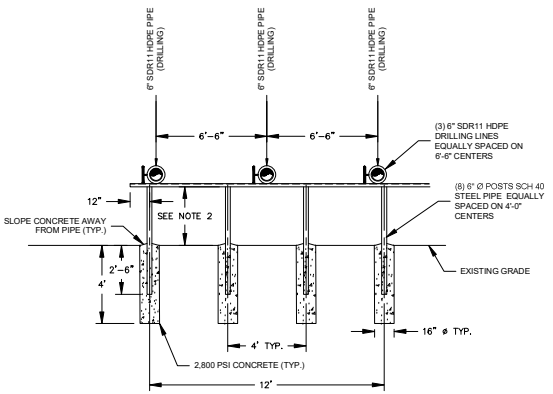
DETAIL 2 - PIPE FRONT ELEVATION COMPLETION



DETAIL 3 - PIPE SIDE ELEVATION TYPICAL



DETAIL 4 - PIPE STAND PLAN VIEW DRILLING



DETAIL 5 - PIPE STAND FRONT ELEVATION DRILLING

NOTES:
1. PIPE STANDS AND ALL PIPES TO BE PAINTED WITH URETHANE ALKYD PAINT. COLORS AS SPECIFIED BY CHEVRON. "INTAKE" OR "DISCHARGE" SHALL BE CLEARLY INDICATED ON THE APPROPRIATE LINES.
2. COMPLETION/DRILLING PIPE STAND HEIGHT ABOVE GRADE AND SPACING BETWEEN STRUCTURAL CHANNELS TO BE DETERMINED IN THE FIELD DEPENDING ON THE EQUIPMENT SPACING ON THE PIPE STAND (TO BE DETERMINED BY CHEVRON)
3. BASKET STRAINERS SHALL BE SUPPORTED CONCRETE STAND OR ALTERNATE FIXED CRIBBING FOUNDATION AS SPECIFIED BY CHEVRON.
4. ALL CONCRETE MATERIAL USED FOR ANCHOR OR BALLAST SHALL BE PREPARED AND CURED TO OBTAIN A MINIMUM COMPRESSIVE STRENGTH OF 2,800 PSI AT 7 DAYS.
5. INTERNAL PIPE PRESSURE SHALL NOT EXCEED 150 PSI.
6. ALL PIPING, VALVES, AND FITTINGS TO BE SPECIFIED BY CHEVRON.

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SCALES:
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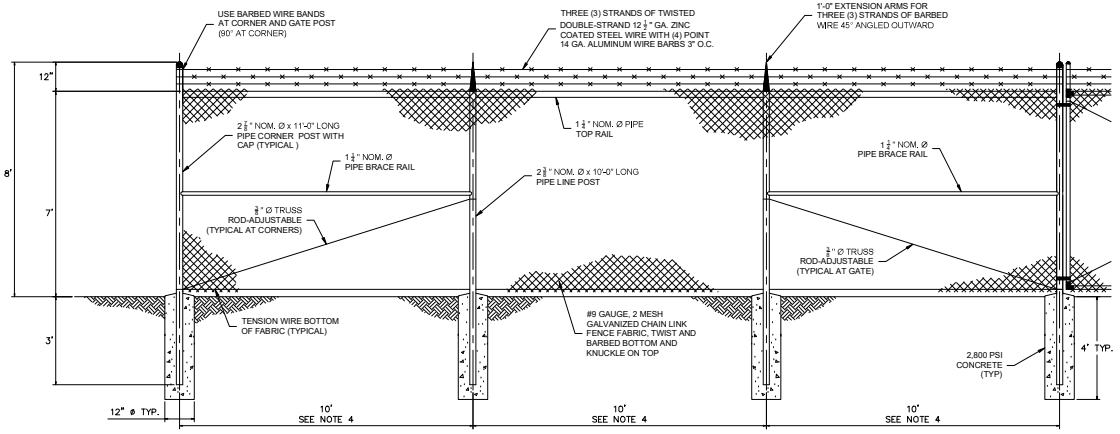
VERTICAL SCALE: NTS

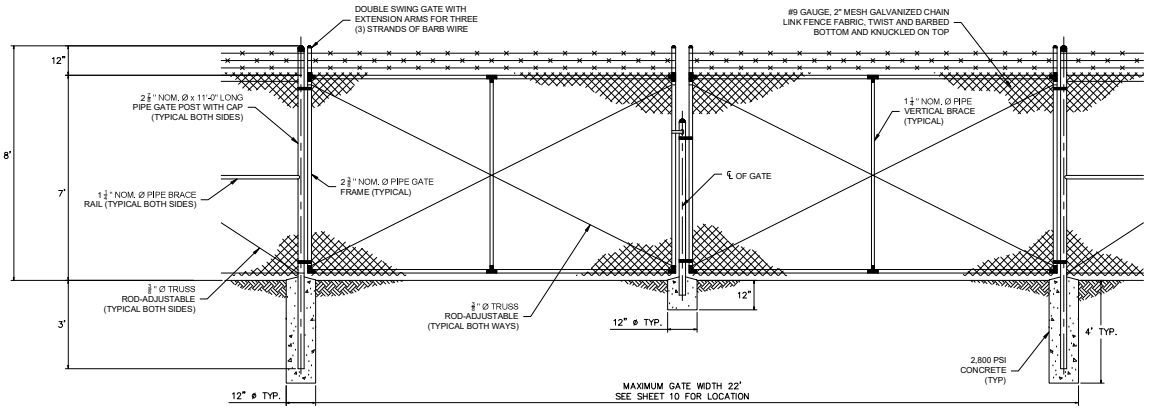
PIPE STAND DETAILS
COTTON DRAW HYDRAULIC FRACTURING POND
LEA COUNTY, NEW MEXICO

PROJECT NO. 01140
DRAWING NO. C-13
SHEET NO. 13 OF 14



TYPICAL CORNER POST BAY | TYPICAL LINE POST BAY | TYPICAL BAY ADJACENT TO GATE

DETAIL 1 - TYPICAL FENCE DETAIL



DETAIL 2 - TYPICAL ACCESS GATE DETAIL

NOTES:
1. ALL POSTS HOLES SHALL BE AUGURED, DO NOT FORM.
2. FOR PLAN AND LOCATION OF GATES, SEE SHEET 10.
3. CONCRETE SHALL REACH A MINIMUM STRENGTH OF 2,800 PSI AT 7 DAYS.
4. LINE POSTS SHALL BE INSTALLED EQUALLY SPACED ALONG FENCE LINE AT A MAXIMUM OF 10' CENTER TO CENTER.
5. ALL WIRE, FENCE FABRIC, POSTS, BRACE RAILS, AND HARDWARE TO BE HOT DIPPED GALVANIZED.

NATHAN A. LANGFORD NEW MEXICO 24399 PROFESSIONAL ENGINEER

REVISIONS		
NO.	DATE	DESCRIPTION
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SCALES:
HORIZONTAL SCALE: 1" = 2'
VERTICAL SCALE: NA

FENCING DETAILS
COTTON DRAW HYDRAULIC FRACTURING POND
LEA COUNTY, NEW MEXICO

PROJECT NO. 01140
DRAWING NO. C-14
SHEET NO. 14 OF 14

Appendix 5 – Recycling Containment Construction Specifications

Technical Specifications

Cotton Draw Area, Section 9, Township 25 South, Range 32 East; Lea County, New Mexico Hydraulic Fracturing Ponds 1 and 2; Specifications for Construction

Chevron North America Exploration and Production
Mid-Continent Business Unit
Lea County, New Mexico

Prepared for:

Chevron North America Exploration and Production
Mid-Continent Business Unit
6301 Deauville, Blvd.
Midland, Texas 79706

Prepared by:

Tetra Tech, Inc.
901 W. Wall St., Suite 100
Midland, Texas 79701
Phone: 432-682-4559

Tetra Tech Project No. 212C-MD-01140

January 2019

SECTION 00 01 10 – TABLE OF CONTENTS

Technical Specifications
Section 00 01 10 – Table of Contents
Section 00 01 15 – List of Drawing Sheets
Section 01 32 00 – Construction Progress Documentation
Section 31 11 00 – Clearing, Grubbing and Stripping
Section 31 23 00 – Earthwork
Section 33 47 13 – Geosynthetics
Section 40 23 00 – Polyethylene Pipe

END OF SECTION 00 01 10

01/18/2019

SECTION 00 01 15 – LIST OF DRAWING SHEETS

PART 1 - GENERAL

1.01 DESCRIPTION

A. The DRAWINGS listed in this SPECIFICATIONS section form part of the contract documents.

B. CONTRACTOR shall completely coordinate the WORK shown on these DRAWINGS with all other contract WORK.

1.02 DRAWINGS INDEX

A. The following DRAWINGS are an integral part of the ENGINEERING DOCUMENTS.

Drawing Sheet Number	Drawing Title
C-1	Cover Sheet
C-2	Existing Site Conditions
C-3	Pond 1 and Pond 2 Excavation Plan
C-4	Pond 1 and Pond 2 Below Grade Staking Plan
C-5	Pond 1 and Pond 2 Site Completion Plan
C-6	Pond 1 and Pond 2 Above Grade Staking Plan
C-7	Pond 1 and Pond 2 Cross-Sections
C-8	Typical Liner and Erosion Control Details
C-9	Sump Cross-Sections and Details
C-10	Site Piping Plan
C-11	Typical Sump Piping Plan
C-12	Typical Pipe Sections
C-13	Pipe Stand Details
C-14	Fencing Details

PART 2 - MATERIALS (NOT USED)

PART 3 - EXECUTION (NOT USED)

SECTION 01 32 00 – CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.01 SUMMARY

A. Requirements of this Section shall consist of CONTRACTOR providing all required construction schedules, and services for the WORK.

B. The CONTRACTOR shall prepare a construction schedule for the OWNER's approval in accordance with the contract documents. The construction schedule shall include project milestones agreed upon by the OWNER as described in this Section.

PART 2 - PRODUCTS

PART 3 - EXCECUTION

3.01 Construction Schedule

A. Within two weeks of notice to proceed, submit a Construction Schedule as described in this section. Allow sufficient time for cycles of review, comment and resubmission so that the final version is delivered to the OWNER or ENGINEER before start of construction activities.

3.02 Daily Reports

A. Submit daily reports on construction progress. These reports should include qualitative descriptions of work performed and include quantities to the extent practicable.

3.03 Weekly Reports

A. Submit weekly reports on construction progress. These reports should include qualitative descriptions of work performed and include weekly summaries of quantities to the extent practicable.

3.04 CPM SUBMITTAL PROCEDURES

A. Submit all network analysis and updates in hard copy and on electronic media that is acceptable to the Engineer. The project schedule will also be posted in the format specified as an Adobe PDF file. For hard copy submittals, a condensed critical path method schedule is preferred but another practicable form of presentation will be acceptable as approved by the Engineer.

3.05 SCHEDULING

A. The CONTRACTOR shall use the critical path method (CPM) to schedule and control construction activities in accordance with the CONTRACT. Schedules shall include start and stop dates, durations for tasks and subtasks and be prepared according to this Section.

3.06 Construction Schedule

A. The CONTRACTOR will:
1. Prepare a detailed schedule in graphic form (Gantt Chart) showing proposed dates of starting and completing each major division of the Work.
2. Develop the Project Schedule to an appropriate level of detail. Failure to develop the Project Schedule to an appropriate level of detail, as determined by the OWNER or ENGINEER, will result in its disapproval.
3. Subdivide tasks so that less than 2 percent of all non-procurement activities have Original Durations (OD) greater than 15 work days or 20 calendar days.

B. The schedule shall identify as a minimum (start to finish and durations):

- Contractor mobilization to site;
- Critical submittals described in this specification (including submission and approval dates);
    - Critical submittals will include the following;
        - Approved Blasting Program and Safety Plan (if required);
        - State/county certifications for blasting program;
        - Grain size distributions for borrow materials;
        - QC Plan for pond construction, testing and geosynthetics installation and testing (in accordance with the specifications);
        - Compaction testing results for each pond;
        - Certifications of pond subgrade acceptance for liner placement for each pond;
        - Panel schedule and final panel layout for each pond;
        - Field seam weld testing, vacuum box, and spark testing results for each pond;
        - Independent laboratory testing of liner;
        - Final as-built of each pond and panel layout as-built;
        - Final QC package documentation;
- Site set up including installation of temporary waste stockpiles, earthwork processing areas and survey control areas;
- Excavation of each Pond;
- Construction of each Pond;
- Finish grade each of the pond subgrade prior to geosynthetics installations;
- Materials/equipment procurement/delivery;
- Installation of the Ponds' geosynthetics;
- Water transfer pumps, piping and associated appurtenances (Specified by Chevron);
- Demobilization;

3.07 Construction Progress Schedule

A. The CONTRACTOR shall propose significant project milestone completions for the OWNER's or ENGINEER's approval as a basis for verifying progression of the pond construction. The project milestones completions shall include the following at minimum:

1. Site clearing and grubbing;
2. Excavation of each Pond; This shall include the following intermediate milestones as approved by the OWNER:
   a. Excavation of 33%, 67%, 100% of the total estimated excavation of each ponds' material or 4 foot incremental decrease of elevation from the existing grade;
3. Compaction of each Ponds' subgrade or floor;
4. Finish grading of each Pond's floor;
5. Benchmark survey for each Pond;
6. Installation of each Ponds' structural berms; This shall include intermediate milestones as proposed and approved by the OWNER, including:
   Installation of 8 lifts for the each of the pond berms or 4 foot incremental increase of elevation from the existing grade AND final grade elevation;
7. Finish grading of each pond;
8. Finish as-built survey of each pond;
9. Installation of secondary geomembrane;
10. Installation of completions and drilling piping, suction, discharge piping and appurtenances;
11. Project Completion and Final QC package documentation including all QC testing results for the Project;

B. The network analysis system shall be kept current, with changes made to reflect the actual progress and status of the construction. Update the construction schedule at monthly intervals or when the schedule has been revised. Reflect any changes occurring since the last update. The schedule should show the progress of work compared to the original project schedule. Application for progress payments will not be processed until the progress schedule is delivered to the OWNER.

END OF SECTION 01 32 00

SECTION 31 11 00 – CLEARING, GRUBBING, AND STRIPPING

PART 1 - GENERAL

1.01 SUMMARY

A. Requirements of this Section shall consist of CONTRACTOR providing all required clearing, grubbing, and stripping related labor, materials, equipment, tools, and services for the WORK.

1.02 DEFINITIONS

A. Clearing: Clearing shall consist of removal of all vegetation and the satisfactory disposal of brush, rubbish, and any other vegetation.

B. Grubbing: Grubbing shall consist of the removal and disposal of roots in excess of 1 inch in diameter, root mats, stumps, logs, peat, and other objectionable matter which could adversely affect the quality of the subgrade or borrow materials.

C. Topsoil: Topsoil is the upper soil horizon which is characterized by a significant organic content.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 AREAS TO BE CLEARED AND GRUBBED

A. Perform clearing and grubbing only in areas identified by the ENGINEER OR OWNER. Clear and grub all areas where WORK is to take place.

B. Clear and grub all borrow areas to the extent necessary to provide fill materials free of all objectionable matter described above.

C. Vegetation located outside the construction limits shall not be damaged.

D. Stripping depths are estimated as 4 to 6 inches for this site, but should be determined by the CONTRACTOR and shall be sufficient to facilitate the clearing and grubbing activities described.

3.02 DISPOSAL OF CLEARED AND GRUBBED MATERIALS

A. All brush (including roots), vegetation, rubbish, organic soils, and other debris from clearing and grubbing operations, including all debris remaining from previous clearing operations, shall be stockpiled separately at a location designated by the OWNER.

3.03 EXCAVATING, STOCKPILING, AND WASTING TOPSOIL

A. If present, excavate topsoil from areas designated for project grading or construction, as encountered. In addition, excavate topsoil from areas designated for use as waste locations for earth subsoil material.

B. Remove lumped soil, vegetative material, boulders, and rocks from the excavated topsoil to be stockpiled.

C. Stockpile, if available, sufficient topsoil material on-site for use as vegetative cover for future reclamation purposes. Protect stockpile from erosion and grade to prevent ponding of water. Organic soils shall be segregated from soil materials that may be suitable for other uses described in these SPECIFICATIONS and shown on the DRAWINGS.

D. Dispose of excess topsoil and waste topsoil not intended for reuse in a location selected by the OWNER. Disposal and handling of this material shall be performed following the requirements of the appropriate government agencies.

END OF SECTION 31 11 00

SECTION 31 00 00 - EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

A. The section describes the following:

1. All excavation required to reach planned grades and contours, install project components, and to construct temporary run-on and run-off conveyance systems.
2. Placement of various fill materials:
   a. Compacted embankment fill
   b. Drainage Aggregate or Drain Rock
3. Material placement and compaction
4. Site grading
5. Construction of fills and backfills
6. Compaction requirements
7. Site grading

B. The WORK shall be done in accordance with the SPECIFICATIONS and as shown on the DRAWINGS.

C. The WORK includes furnishing all labor, tools, materials, equipment, and supervision necessary to construct the project as described in the contract documents.

1.02 TOLERANCES

A. All excavations shall be constructed within the tolerance as shown in these SPECIFICATIONS except where dimensions or grades are shown or specified as minimum or maximum in the DRAWINGS. All grading shall be performed to maintain slopes and drainages as shown in the DRAWINGS.

B. Excavate to within a horizontal and vertical tolerance of ± 0.1 -foot on all slopes flatter than 10% and within a vertical tolerance of ± 0.2 -foot on all slopes 10% or steeper unless otherwise approved by the ENGINEER or OWNER.

1.03 SUBSURFACE CONDITIONS

A. Subsurface investigations have been performed at the site by the ENGINEER. The results of the subsurface investigations should be provided to the CONTRACTOR by the OWNER during the bidding interval.

B. The CONTRACTOR shall identify and locate utility lines, flow lines, wells, survey monuments, and other nearby structures prior to performing work. Utilities, flow lines, wells, survey monuments and other nearby structures shall be protected from damage during the WORK. Any damage to utility lines, flow lines, wells, survey monuments, and other nearby structures

during the WORK shall be repaired by the CONTRACTOR at no additional cost to the OWNER. Costs associated with these repairs shall include the actual repair costs and all engineering costs required by the ENGINEER to coordinate and obtain regulatory approval of repairs, if required.

1.04 SUBMITTALS

A. Imported materials that may include engineered structural fill or others shall have material properties such as grain size distribution submitted to the OWNER or ENGINEER for material approval prior to delivery to the site.

1.05 REFERENCES

A. American Society for Testing and Materials (ASTM):
1. ASTM D698 – Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort
2. ASTM D2434 – Test Method for Permeability of Granular Soils
3. ASTM D6913 – Test Method for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
4. ASTM D6938 – Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

B. TXDOT ITEM 247 – Flexible Base

C. Tetra Tech, Inc. – Report of Geotechnical Study, Cotton Draw Impoundments, Lea County, New Mexico, Section 9, Township 25 South, Range 32 East, dated July 18, 2018.

1.06 DEFINITIONS

A. Liner – A completed system constructed as required by the DRAWINGS and SPECIFICATIONS, as specified in Section 33 47 13.

PART 2 - PRODUCTS (NOT USED)

2.01 ENGINEERED FILL

A. Engineered Fill is defined as material obtained from excavations associated with the WORK or designated on-site borrow area, or imported off-site borrow sources, approved by the ENGINEER, that meet the requirements of the SPECIFICATIONS.

B. Engineered Fill material shall be free of debris, organics, oversized material (clods or rocks greater than 1 inches in diameter), frozen material, ice, snow, deleterious, or other unsuitable materials.

C. The aggregate to be used for the Engineered Fill material should conform to the requirements as shown in TXDOT item 247, Table 1, Grade 1. Each source must meet Table 1 requirements for liquid limit, plasticity index, and wet ball mill for grade 1. Do not use additives such as, but not

limited to lime, cement, or fly ash, to modify aggregate to meet requirement of Table 1. As per the geotechnical study, the on-site material meets these requirements and are suitable as engineered fill.

D. The OWNER may allow the following as an alternative to item 'C' in this Section, if requested, and only if the OWNER has authorized their ENGINEER or the ENGINEER's appointed representative to be on site observing the placement of Engineered Fill for the duration of the project. As an alternative fill material option to item 'C' in this Section, Engineered Fill for structural support shall consist of a uniform, granular material having 100 percent passing the 3 inch sieve, 30 to 100 percent passing the 1 inch (25mm) sieve, and 10 to 60 percent passing the number 200 sieve. As per the geotechnical study, the on-site material meets these requirements and are suitable as engineered fill.

E. The CONTRACTOR will provide laboratory testing results to the OWNER for all fill material used in construction for verification of material compliance as required for the project.

F. Materials excavated from depths greater than five to seven feet below surface will likely require additional processing to meet the specifications for use as Engineered Fill.

2.02 ENGINEERED FILL MATERIAL USED IN SUBGRADE PREPARATION

A. Engineered Fill used for subgrade preparation of the pond bottom, interior embankment slopes, and sump shall be screened or crushed on-site soils or imported material. Engineered Fill used for the upper six inches of the pond bottom, interior embankment slopes, and sump shall be regular, smooth, and compacted; and shall be free of sharp changes in elevation, rocks larger than 1.0 inch, clods, roots, organic debris, and standing water, other unsuitable objects, deleterious materials, or soft unsuitable areas. One hundred percent of the prepared subgrade soil material gradation shall pass the 1-inch sieve, 30 to 70 percent passing the U.S. standard #4 sieve, and 10 to 60 percent passing the # 200 sieve.

B. Imported fills may be used and should be a well-graded, sand (SW), silty sand (SM), clayey sand (SC) or low plasticity clay (CL), or other imported soils with similar properties as on site soils. Imported fills shall meet the gradation specified in this Section.

C. Engineered fill material used for the prepared pond bottom shall meet the liner manufacturer's specifications for material suitable for liner placement.

PART 3 - EXECUTION

3.01 PREPARATION, EXAMINATION, AND PROTECTION OF EARTHWORK

A. Provide construction staking and grade control. Establish and set required lines, levels, grade, contours and datum by construction staking.

B. Provide for dust control in accordance with site requirements and OWNER'S direction.

C. Provide for dewatering as necessary for finish excavation and fill placement.

D. Locate, identify and protect all utilities and existing structures from damage (including overhead and suspended utilities).

E. Protect temporary or permanent bench marks, survey stakes, settlement monuments, existing structures, fences and existing WORK from damage or displacement by construction equipment and vehicular traffic.

F. Coordinate traffic control, operations, and haul routes with the OWNER and LINER CONTRACTOR.

G. Note that topography shown on DRAWINGS may differ from topography at time of construction.

H. Protect the foundation from drying, freezing, and softening due to excessive moisture until overlying fill material is placed and compacted.

I. Any earthen surface upon which the liner is installed shall be prepared and compacted in accordance with the project SPECIFICATIONS. The surface shall be smooth, firm, and unyielding. The top six inches of fill beneath the surface shall be free of:

1. Vegetation and roots
2. Construction debris
3. Sticks
4. Sharp, angular rocks
5. Rocks larger than 1 inch in diameter
6. Void spaces
7. Abrupt elevation changes
8. Standing water
9. Cracks larger than six millimeters in width
10. Any other foreign matter that could contact the liner

J. Immediately prior to liner deployment, LINER CONTRACTOR shall arrange for the subgrade to be moisture-conditioned and final-graded by the EARTHWORK CONTRACTOR to fill in all voids or cracks, then smooth-rolled to provide the best practicable surface for the liner. At completion of this activity, no wheel ruts, footprints or other irregularities in the subgrade are permissible. Furthermore, all protrusions extending more than 0.5-inches from the surface shall be removed, crushed, or pushed into the surface with a smooth-drum roller compactor.

K. On a continuing basis, the OWNER's REPRESENTATIVE shall examine the subgrade for suitability before liner placement.

L. It shall be the CONTRACTOR'S responsibility to indicate to the OWNER or ENGINEER any change in the condition of the subgrade that could cause the subgrade to be out of compliance with any SPECIFICATION requirement. If the CONTRACTOR has not notified the OWNER or ENGINEER of changes that cause the subgrade to be out of compliance and installs liner then the CONTRACTOR has determined that the subgrade is acceptable for liner installation.

M. At the crest of the embankments, an anchor trench for the liner shall be constructed by the EARTHWORK CONTRACTOR as detailed on the DRAWINGS. Any deviation from the anchor trench details shown on the DRAWINGS requires review and approval by the

ENGINEER. No loose soil shall be allowed at the bottom of the trench, and no sharp corners or protrusions shall exist anywhere within the trench.

N. Verify as applicable that all underlying components such as geosynthetics and piping have been installed, tested, and accepted in accordance with the DRAWINGS and SPECIFICATIONS.

3.02 EXCAVATION

A. Excavate material shown on the DRAWINGS and as necessary to complete the WORK. Excavation carried below the grade lines shown on the drawings shall be repaired as specified by the OWNER unless previously approved by the OWNER. Correction of all over-excavated areas shall be at the CONTRACTOR's sole expense.

B. All necessary precautions shall be taken to preserve the material below and beyond the established lines of all excavation in the soundest possible condition. Any damage to the WORK beyond the required excavation lines due to wetting, drying, or the CONTRACTOR'S operations shall be repaired at the CONTRACTOR'S sole expense.

C. Excavation, shaping, and any other work related to material removal, shall be carried out by the method(s) considered most suitable, provided it meets the design intent as determined by the ENGINEER.

D. Limits of excavation to accomplish the WORK safely shall be determined by the CONTRACTOR. Any minimum excavation limits shown on the DRAWINGS are for the purpose of material identification only and do not necessarily represent safe limits. All excavations shall be free of overhangs, and the sidewalls shall be kept free of loose material. As a minimum, the CONTRACTOR shall slope, bench and shore all excavations as necessary to prevent any unsafe conditions as required by OSHA 29 CFR 1926.651 and 1926.652.

E. Excavation of hard soil below about five to seven feet in depth may be difficult and may require ripping.

F. Accurate trimming of the slopes of excavations to be filled will not be required, but such excavations shall conform as closely as practical to the established lines and grades.

G. For pipe/riser/collection trench excavations, grade trench bottom to provide uniform bearing for the entire length of pipe to be installed. Fill in voids, gaps, low points ("dips" or "bellys") and bridging areas within trench bottom and along the entire length of pipe.

H. Subsoil not to be used in the construction of earth fills or reclamation shall be stockpiled in areas designated by OWNER and in accordance with applicable laws, rules, and regulations.

I. Permanently stockpiled earth material shall be graded to drain and blended seamlessly into the natural landscape.

J. Provide and operate equipment adequate to keep all excavations and trenches free of water.

K. Excavate unsuitable areas of the subgrade and replace with approved fill materials. Compact to density equal to requirements for subsequent fill material.

L. When possible, grade top perimeter of excavation to prevent surface water from draining into excavation.

M. Grade top perimeter of excavation to prevent surface water from draining into excavation.

3.03 FILL PLACEMENT

A. General

1. **The top 8 inches of the foundation subgrade surface shall be scarified, moisture conditioned (as necessary), and compacted so fill material will bond firmly to surfaces of excavation.** Remove standing water prior to placement of all fill material.
2. Transport, process, place, spread, and compact fill using appropriate equipment to achieve lift thickness, design grades and compaction specified in the DRAWINGS and SPECIFICATIONS.
3. To the extent practicable, fill shall be placed by routing the hauling and spreading units approximately parallel to the axis of the embankment.
4. Hauling equipment shall be routed in such a manner that they do not follow in the same paths but spread their traveled routes evenly over the surface of the fill.
5. Protect installed measurement instrumentation, structures, and utilities from damage at all times.
6. Care shall be taken at all times to avoid segregation of material being placed, and all pockets of segregated or undesirable material shall be removed and replaced with material matching the surrounding material.
7. Each zone shall be constructed with materials meeting the specified requirements and shall be free from lenses, pockets, and layers of materials that are substantially different in gradation from surrounding material in the same zone.
8. No material shall be placed on material that is too soft, smooth, wet, or dry, or that has been damaged by drying, cracking, frost, runoff, or construction activities. Previously completed portions of the subgrade that are deemed unsuitable for construction shall be repaired until approved by the ENGINEER.
9. To the extent practicable, fill materials shall be brought to the placement area at the recommended moisture content.
10. Moisture conditioning is the operation required to increase or decrease the moisture content of material to within the specified limits for proper material placement and compaction. If moisture conditioning is necessary, it may be carried out by whatever method CONTRACTOR deems suitable, provided it produces a uniform material moisture content specified in the SPECIFICATIONS.

3.04 MOISTURE CONTROL

A. Prior to and during all compacting operations, maintain moisture content within the limits recommended herein. Maintain uniform moisture content throughout the lift. To the extent practicable, add water to materials that are too dry at the site of excavation. Supplement, if necessary, by sprinkling and mixing water into the fill material prior to compaction. The moisture content shall be within 2 percent below to 2 percent above the optimum moisture content in accordance with ASTM D 698[1].

B. Do not attempt to compact fill material containing excessive moisture. Aerate material by blading, disking, harrowing, or other methods, to dry the material to acceptable moisture content.

3.05 LIFT THICKNESS REQUIREMENTS

A. Berm Fill:

1. Placement of loose lift thickness for Engineered Fill shall not exceed 6 inches prior to compaction with hand-operated compaction equipment and shall not exceed 10 inches prior to compaction with heavy machine operated equipment. In order to meet the specifications, it is recommended that lifts not exceed 8 inches with heavy machine operated compaction equipment. It is the CONTACTOR's responsibility to ensure that the compaction achieved meets the specifications.
2. Fill placement for anchor trenches shall not exceed 6 inches in loose depth for each respective lift.

3.06 COMPACTION AND MOISTURE CONTENT REQUIREMENTS

A. After material placement, spreading, and leveling to the appropriate lift thickness, all material shall be uniformly compacted in accordance with the requirements for each type of fill as indicated on the following table:

Table 3.1 - Compaction and Moisture Content Requirements

Fill Material	Compaction Specifications[1]	Moisture Content[1]
Engineered Fill	95% of Standard Proctor maximum dry density	-2 to +2% of Optimum

[1]As determined by ASTM D698

3.07 COMPACTION EQUIPMENT

A. Compaction equipment shall be maintained in good working condition at all times to ensure that the amount of compaction obtained is the maximum for the equipment.

B. Compactor:

1. The fill is required to be compacted with a relatively heavy vibratory roller and a maximum roller speed of approximately 2 mph.
2. The compactor shall be of self-propelled design to develop 10,000 pounds in weight per linear foot of width at rest on level ground or equivalent as approved by the ENGINEER.

C. Special Compactors:

1. Special compactors shall be used to compact materials that, in the opinion of the ENGINEER, cannot be compacted properly by the specified roller because of location or accessibility.
2. Special compaction measures shall be adopted, such as hand-held compactors, smooth drum rollers, or other methods approved by the ENGINEER, to compact fill material in

trenches, around structures, around geosynthetics, and in other confined areas that are not accessible to the Compactor. The final surface on which the geosynthetics will be placed shall be compacted with a smooth drum roller.

3. Anchor trenches shall be compacted with a hand-operated compactor.

3.08 COMPACTION TESTING OF ENGINEERED FILL

A. Field compaction testing of each lift shall be performed a minimum of one test every 150 linear feet or 5000 square feet.

B. Compaction testing of anchor trenches shall be performed such that puncturing of the geosynthetic materials is avoided.

3.09 SITE GRADING

A. Perform all placement of fill to lines and grades as shown in the DRAWINGS and/or established by the ENGINEER, with proper allowance for surface treatments (topsoil placement, etc.) where specified or shown. Neatly blend all new grading into surrounding, existing terrain.

END OF SECTION 31 00 00

SECTION 33 47 13 – GEOSYNTHETICS

SECTION 33 47 13.14 – GEOMEMBRANE

PART 1 - GENERAL

1.01 SUMMARY

A. The WORK described in this SPECIFICATION section includes specifications for manufacturing and installing HDPE geosynthetics.

1.02 SUBMITTALS

A. The CONTRACTOR shall submit a letter to the OWNER prior to installation of the geosynthetics stating the subgrade is acceptable and does not void the warranty.

B. The CONTRACTOR shall submit the following product data to the ENGINEER or the OWNER'S CQA ADMINISTRATOR:
   1. Resin Data:
      a. Certification stating that the resin meets the SPECIFICATION requirements.
   2. Geosynthetics Roll:
      a. Statement certifying no recycled polymer and no more than 10% rework of the same type of material is added to the resin.

C. Pre-Construction Submittals: Submit the following within 10 days of Notice to Proceed. Pre-Construction materials shall be submitted to the OWNER and ENGINEER or the OWNER'S CQA ADMINISTRATOR.

   1. The MANUFACTURER'S Information
      a. The MANUFACTURER'S name and address and primary contact.
      b. The manufacturing plant name and address where the geosynthetics for this project will be produced.
      c. The MANUFACTURER'S qualifications including:
         1) Evidence of production of at least 10 million square feet of geomembrane that meets the specifications.
         2) Certification that the MANUFACTURER has sufficient capacity to provide the required material in the given timeframe.
         3) A list of at least 10 projects for which geomembrane has been supplied by the MANUFACTURER, three of which shall have been for projects of similar size.
      d. Product name and the MANUFACTURER'S description of the proposed geosynthetics and five representative samples of the product proposed for use on this project.
      e. The MANUFACTURER'S material properties sheets (cut sheets) of proposed geosynthetic products meeting the requirements of the specification.

f. The MANUFACTURER'S Quality Control (MQC) Plan, including examples of geosynthetics certification documents, name and address of the quality control testing laboratory, quality control laboratory certification, examples of retesting notification, and documentation.
g. The MANUFACTURER'S written instructions for storing, handling, installing, seaming, protecting from hydration, and repairing the proposed geosynthetics, including recommendations for handling equipment (model number and load capacity).
h. Samples product warranty.

2. CONTRACTOR'S Information:
   a. CONTRACTOR'S name and address and primary contact.
   b. CONTRACTOR'S qualifications including a list of at least three previous projects of similar size to this project, including project name, location, size and date of installation, and evidence of installing at least 1 million square feet of geomembrane.
   c. The Construction Quality Control (CQC) Plan, including examples of subgrade certification documents, daily record documents, methods for repairing geomembrane and subgrade and example documents to certify repairs, method for removing rejected materials, proposed staffing, and proposed equipment.
   d. Description of welding equipment, techniques, and material, including a list of proposed equipment.
   e. A complete set of forms to be used for record installation CQC data.
   f. Résumés of key installation personnel. The Installation Supervisor, Master Seamers, and QC Representative must be clearly identified.
   g. Workmanship warranty.

D. The CONTRACTOR shall furnish SHOP DRAWINGS to the OWNER and ENGINEER or the OWNER'S CQA ADMINISTRATOR as follows:

1. Installation layout SHOP DRAWINGS.
   a. Must show proposed panel layout including field seams and details.
   b. Must show panel identification numbers.
   c. Installed square footage of the geomembrane.
   d. Must be approved prior to installing the geomembrane.
   e. Approved SHOP DRAWINGS will be for concept only and actual panel placement will be determined by site conditions.

E. CONTRACTOR'S geosynthetics field installation quality assurance plan.

F. The CONTRACTOR will submit the following to the OWNER and ENGINEER or the OWNER'S CQA ADMINISTRATOR upon completion of installation:

1. Certificate stating the geosynthetics have been installed in accordance with the contract documents.
2. Material and installation warranties:
   a. Material shall be warranted against MANUFACTURER's defects for a period of five years from the date of geosynthetics installation.
   b. Installation shall be warranted against defects in workmanship for a period of one year from the date of geosynthetics completion.
3. Subgrade Certification Document

4. Final CQC daily record documents.
5. Final as-built drawings showing actual geosynthetics placement, seams, testing locations and results, and anchor trench details.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM D792 – Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
2. ASTM D1004 – Test Method for Initial Tear Resistance of Plastic Film and Sheeting
3. ASTM D1238 – Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
4. ASTM D1603 - Standard Test Method for Carbon Black Content in Olefin Plastics
5. ASTM D3895 – Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
6. ASTM D4218 – Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
7. ASTM D4716 - Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
8. ASTM D4873 Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
9. ASTM D4833 – Test Method for Index Puncture Resistance of Geomembranes and Related Products
10. ASTM D5035 - Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
11. ASTM D5199 - Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
12. ASTM D5596 – Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
13. ASTM D5641 – Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber
14. ASTM D5820 – Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes
15. ASTM D5885 - Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry
16. ASTM D5994 – Test Method for Measuring Core Thickness of Textured Geomembrane
17. ASTM D6364 - Standard Test Method for Determining Short-Term Compression Behavior of Geosynthetics
18. ASTM D6392 – Test Method for Determining the Integrity of Non-reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
19. ASTM D6693 – Test Method for Determining Tensile Properties of Non-reinforced Polyethylene and Non-reinforced Flexible Polypropylene Geomembranes
20. ASTM D7179 - Standard Test Method for Determining Geonet Breaking Force
21. ASTM D7240 - Standard Practice for Leak Location using Geomembranes with an Insulating Layer in Intimate Contact with a Conductive Layer via Electrical Capacitance Technique (Conductive Geomembrane Spark Test).
22. ASTM D7406 - Standard Test Method for Time-Dependent (Creep) Deformation Under Constant Pressure for Geosynthetic Drainage Products

23. ASTM D7466 – Standard Test Method for Measuring the Asperity Height of Textured Geomembrane

B. Geosynthetic Research Institute (GRI)
1. GRI-GC8 Standard Guide for Determination of the Allowable Flow Rate of a Drainage Geocomposite
2. GRI GM14 - GM Sampling by Attributes
3. GRI GM10 – Specification for the Stress Crack Resistance of Geomembrane Sheet
4. GRI GM19 - Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes.

1.04 DEFINITIONS

A. Lot – A quantity of resin (usually the capacity of one rail car) used in the manufacture of geosynthetics. Finished roll will be identified by a roll number traceable to the resin lot used.

B. ENGINEER – Party, independent from manufacturer and CONTRACTOR, that is responsible for the engineering design of the liner system installation and as appointed by the OWNER as the Party responsible for observing and documenting activities related to quality assurance during the lining system construction.

C. OWNERs CQA ADMINISTRATOR – Party, independent from manufacturer and CONTRACTOR, that is responsible for observing and documenting activities related to quality assurance during the lining system construction.

D. Geosynthetics Manufacturer – The party responsible for manufacturing the geosynthetics rolls.

E. Geosynthetic Quality Assurance Laboratory (testing laboratory) – Party, independent from the OWNER, manufacturer, and CONTRACTOR, responsible for conducting laboratory tests on samples of geosynthetics obtained at the site or during manufacturing.

F. CONTRACTOR – Party responsible for field handling, transporting, storing, deploying, seaming and testing of the geomembrane seams.

G. Minimum Average Roll Value (MARV): Property value calculated as typical minus two standard deviations. Statistically, it yields a 97.7% degree of confidence that any sample taken during quality assurance testing will exceed value reported.

H. Panel – Unit area of a geomembrane that will be seamed in the field that is 10 square yards or larger.

I. Patch – Unit area of a geomembrane that will be seamed in the field that is less than 10 square yards.

J. Subgrade Surface – Soil layer surface which immediately underlies the geosynthetic material(s).

1.05 QUALIFICATIONS

A. MANUFACTURER

1. MANUFACTURER shall have manufactured a minimum of 10 million square feet of HDPE geomembrane material during the last year.
2. MANUFACTURER shall have a GAI-LAP Accredited Laboratory at the manufacturing facility.
3. MANUFACTURER shall have ISO 9001; 2008 certification.

B. CONTRACTOR

1. CONTRACTOR shall have installed a minimum of 1,000,000 square feet of geosynthetics in the last 3 years.
2. CONTRACTOR shall have worked in a similar capacity on at least 3 projects similar in complexity to the project described in the contract documents, and within a total of at least 400,000 square feet of geomembrane installation on each project.
3. The Installation Supervisor shall have worked in a similar capacity on at least 3 projects similar in size and complexity to the project described in the Contract Documents in the last 5 years.

1.06 MATERIAL LABELING, DELIVERY, STORAGE, AND HANDLING

A. Geosynthetics labeling, shipment, and storage shall follow ASTM D4873. Product labels shall clearly show the manufacturer or supplier name, style name, and roll number.

B. The CONTRACTOR shall note any visible damage to roll materials on the Bill of Lading prior to unloading roll materials. Should any visible damage be noted, CONTRACTOR or ENGINEER shall notify the MANUFACTURER in writing immediately.

C. Labeling – Each roll of geosynthetics delivered to the site shall be labeled by the manufacturer. The label will identify:

1. Manufacturer's name
2. Product identification
3. Thickness
4. Length
5. Width
6. Roll number
7. Date and time of production
8. Resin lot number

D. Delivery – Rolls of liner will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.

E. Storage – The on-site storage location for geosynthetics material, provided by the CONTRACTOR to protect the geosynthetics from punctures, abrasions and excessive dirt and moisture, should have the following characteristics:

1. Level (no wooden pallets)
2. Smooth
3. Dry
4. Protected from theft and vandalism
5. Adjacent to the area being lined

6. Geosynthetics shall not be stacked higher than three rolls

F. Handling – Materials are to be handled so as to prevent damage. The CONTRACTOR shall take any necessary precautions to prevent damage to underlying layers during placement of the geosynthetics.

1.07 WARRANTY

A. Material shall be warranted, against manufacturer's defects for a period of five years from the date of geosynthetics installation.

B. Installation shall be warranted against defects in workmanship for a period of one year from the date of geosynthetics completion.

PART 2 - PRODUCTS

2.01 HIGH DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE

A. Material shall be HDPE geomembrane meeting the thickness, texture, and color requirements as shown on the DRAWINGS.

B. Geomembrane Rolls

1. Geomembrane rolls must not exceed a combined maximum total of 1 percent by weight of additives other than carbon black.
2. Geomembrane shall be free of holes, pinholes, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.
3. Geomembrane material is to be supplied in roll form. Each roll is to be identified with labels indicating roll number, thickness, length, width, and manufacturer.
4. All liner sheets produced at the factory shall be inspected prior to shipment for compliance with the physical property requirements listed in Tables 2.1 and 2.2; and be tested by an acceptable method of inspecting for pinholes. If pinholes are located, identified and indicated during manufacturing, these pinholes may be corrected during installation.

C. Geomembrane roll testing values for 60-mil smooth HDPE and testing frequencies requirements are presented in Table 2.1 below. Geomembrane roll testing values for 60-mil textured HDPE and testing frequencies requirements are presented in Table 2.2 below.

TABLE 2.1: MINIMUM VALUES FOR 60-MIL SMOOTH HDPE GEOMEMBRANES

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE
Thickness, (minimum average) mil Lowest individual value	ASTM D5994 / D5199	Every roll	57 54
Density, g/cm3	ASTM D792	200,000 lb	0.940
Tensile Properties (each direction) Strength at Break, lb/in-width Elongation at Break, %	ASTM D 6693, Type IV Dumbbell, 2 in/min G.L. = 2.0 in	20,000 lb	228 700
Tear Resistance, lb	ASTM D1004	45,000 lb	42
Puncture Resistance, lb	ASTM D4833	45,000 lb	108
Carbon Black Content, %	ASTM D1603*/4218	20,000 lb	2.0 – 3.0
Carbon Black Dispersion Oxidative Induction Time, min (Standard OIT)	ASTM D5596 ASTM D3895, 200° C; 02, 1 atm	45,000 lb 200,000 lb	(+Note 1) ≥ 100
Melt Flow, g/10 min.	ASTM D1238, 190° C; 2.16kg	200,000 lb	≤ 1.0
Oven Aging With HP OIT, (% retained after 90 hours)	ASTM D5721 ASTM D5885, 150° C; 500 psi O_2	Per resin formulation	80
UV Resistance With HP OIT, (% retained after 1600 hours)	ASTM D5885, 150° C; 500 psi O_2	Per resin formulation	50 (+Note 2)

+NOTE 1: DISPERSION ONLY APPLIES TO NEAR SPHERICAL AGGLOMERATES. 9 OF 10 VIEWS SHALL BE CATEGORY 1 OR 2. NO MORE THAN 1 VIEW FROM CATEGORY 3.
+NOTE 2: 20-HOUR CYCLE AT 75° C/4 HR DARK CONDENSATION @ 60° C.
*MODIFIED.

TABLE 2.2: MINIMUM VALUES FOR 60-MIL TEXTURED HDPE GEOMEMBRANES

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE
Thickness, (minimum average) mil Lowest individual value	ASTM D5994 / D5199	Every roll	57 54
Asperity Height (mil) (+Note 1)	ASTM D7466	Every second roll	16
Density, g/cm3	ASTM D792	200,000 lb	0.940
Tensile Properties (each direction) Strength at Break, lb/in-width Elongation at Break, %	ASTM D 6693, Type IV Dumbbell, 2 in/min G.L. = 2.0 in	20,000 lb	90 100
Tear Resistance, lb	ASTM D1004	45,000 lb	42
Puncture Resistance, lb	ASTM D4833	45,000 lb	90
Carbon Black Content, %	ASTM D1603*/4218	20,000 lb	2.0 – 3.0
Carbon Black Dispersion Oxidative Induction Time, min (Standard OIT)	ASTM D5596 ASTM D3895, 200° C; 02, 1 atm	45,000 lb 200,000 lb	(+Note 2) ≥ 100
Melt Flow, g/10 min.	ASTM D1238, 190° C; 2.16kg	200,000 lb	≤ 1.0
Oven Aging With HP OIT, (% retained after 90 hours)	ASTM D5721 ASTM D5885, 150° C; 500 psi O_2	Per resin formulation	80
UV Resistance With HP OIT, (% retained after 1600 hours)	ASTM D5885, 150° C; 500 psi O_2	Per resin formulation	50 (+Note 3)

+NOTE 1: ASPERITY PARAMETER PROVIDED FOR TEXTURED GEOMEMBRANE AND RUB SHEETS. 60-MIL TEXTURED HDPE GEOMEMBRANE SHALL MEET OTHER PARAMETERS IDENTIFIED IN TABLE 2.3. FIELD SEAM OR DESTRUCTIVE TESTING OF TEXTURE LINER USED FOR RUB SHEETS IS NOT REQUIRED.
+NOTE 2: DISPERSION ONLY APPLIES TO NEAR SPHERICAL AGGLOMERATES. 9 OF 10 VIEWS SHALL BE CATEGORY 1 OR 2. NO MORE THAN 1 VIEW FROM CATEGORY 3.
+NOTE 3: 20-HOUR CYCLE AT 75° C/4 HR DARK CONDENSATION @ 60° C.
***Modified.**

2.02 RESIN

1. Resin shall be first quality, compounded polyethylene resin.
2. Natural resin (without carbon black) shall meet the following additional minimum requirements:

TABLE 2.3: RAW MATERIAL VALUES

Property	Test Method [(1)]	Testing Frequencies	Value
Density (g/cm3)	ASTM D 1505	Once Per Resin Lot	>0.94
Melt Flow Index (g/10 min)	ASTM D 1238	Once Per Resin Lot	≤ 1.0

[1]Manufacturer may utilize test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics.

2.03 EQUIPMENT

A. Welding equipment and accessories shall meet the following requirements:

1. Gauges showing temperatures in apparatus (extrusion welder) or wedge (wedge welder) shall be present.
2. An adequate number of welding apparatus shall be available to avoid delaying WORK.
3. Power source must be capable of providing constant voltage under combined line load.

B. Extrudate Rod or Bead

1. Extrudate material shall be made from the same type of resin as the geomembrane.
2. Additives shall be thoroughly dispersed.
3. Materials shall be free of contamination by moisture or foreign matter.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Preparation of surfaces to be lined shall be completed by the EARTHWORKS CONTRACTOR but the LINER CONTRACTOR will be responsible for inspecting the prepared surfaces to verify that the surfaces are acceptable for liner placement and free from any rocks, clods, sticks, roots, surface irregularities or debris which could damage the liner. Acceptance of the subgrade shall be provided in a written submittal.

3.02 DEPLOYMENT

A. Assign each panel a simple and logical identifying code. The coding system shall be subject to approval and shall be determined at the WORK site.

B. Visually inspect the geosynthetics during deployment for imperfections and mark faulty or suspect areas.

C. Deployment of geosynthetics panels shall be performed in a manner that will comply with the following guidelines:

1. Unroll geosynthetics using methods that will not damage geosynthetics and will protect underlying surface from damage (spreader bar, protected equipment bucket).
2. The geosynthetics roll shall be installed in the direction of the slope and in the intended direction of flow unless otherwise specified by the ENGINEER.
3. Use full length rolls or those with a significant length remaining at the top of the slope so that no roll end occurs on side slopes.
4. Place ballast (commonly sandbags) on geosynthetics, which will not damage geosynthetics, to prevent wind uplift.
5. Personnel walking on geosynthetics shall not engage in activities or wear shoes that could damage it. Smoking will not be permitted on the geosynthetics.
6. Do not allow heavy vehicular traffic directly on geosynthetics. Rubber-tired ATVs and trucks are acceptable if wheel contact is less than six pounds per square inch.

D. Sufficient material (slack) shall be provided to allow for thermal expansion and contraction of the material. Additionally, weighting (e.g., sandbags) should be used to control "walking" of the liner leading to accumulation of wrinkles or conversely high tension areas at slope toes and corner groins. This practice will be used to prevent excessive tension (trampolines) from developing. This is particularly important in cold weather conditions. Liners shall be installed to prevent "trampolining" from occurring in cold weather conditions (i.e. 35˚F or less).

E. Anchor trench compacting equipment shall not come into direct contact with the geosynthetics. The specified fill material shall be placed and spread utilizing vehicles with a low ground pressure.

F. Liner deployment shall not proceed when adverse weather conditions jeopardize the integrity of the liner installation. For installation integrity and safety purposes, liner deployment shall be monitored continuously and ballast shall be installed properly to keep wind from causing uplift to the liner. The CONTRACTOR shall demonstrate that safe and acceptable liner deployment can be performed without damage to the liner panels or injury to personnel. Liner deployment shall not proceed when wind speeds are above 29 mph.

3.03 FIELD SEAMING

A. Seams shall meet the following requirements:

1. To the maximum extent possible, orient seams parallel to line of slope, i.e., down and not across slope.
2. Minimize number of field seams in corners, odd-shaped geometric locations and outside corners.
3. Slope seams (panels) shall extend a minimum of five feet beyond the grade break into the flat area.
4. Use a sequential seam numbering system compatible with panel numbering system that is agreeable to the ENGINEER or the OWNER'S CQA ADMINISTRATOR and CONTRACTOR.
5. All seam overlaps shall be aligned consistent with the requirements of the welding equipment being used. Seams shall be made by lapping the uphill material over the downhill material with sufficient overlap. Extrusion seaming shall have a minimum overlap of six inches. Wedge-welded seaming shall have a minimum overlap of six inches.
6. Seaming of the geomembrane at material temperatures below 32 degrees F and above 170 degrees F must be successfully demonstrated to the ENGINEER or the OWNER'S CQA ADMINISTRATOR using prequalification test seams to demonstrate that the seams comply with these SPECIFICATIONS.

B. During Welding Operations

1. Provide at least one master seamer who shall provide direct supervision over other welders as necessary.

C. Extrusion Welding

1. Hot-air tack adjacent pieces together using procedures that do not damage the geomembrane.

2. Clean geomembrane surfaces by disc grinder or equivalent. Number 80-grit sandpaper shall be used.
3. Grinding shall not reduce the thickness of the geomembrane more than one mil.
4. Purge welding apparatus of heat-degraded extrudate before welding.
5. Extrusion welding shall be considered a secondary means of welding and shall be used for repairs unless otherwise approved by ENGINEER.

D. Hot Wedge Welding

1. Welding apparatus shall be a self-propelled device equipped with an electronic controller which displays applicable temperatures.
2. Clean seam area of dust, mud, moisture and debris immediately ahead of hot wedge welder.
3. Protect against moisture build-up between sheets.
4. Hot wedge welding shall be considered the primary method of welding and shall be used for panel seaming unless otherwise approved by ENGINEER.

E. Trial Welds

1. Perform trial welds on geomembrane samples to verify welding equipment is operating properly.
2. Make trial welds under the same surface and environmental conditions as the production welds, i.e., in contact with subgrade and similar ambient temperature.
3. A minimum of two trial welds shall be required per day, per welding apparatus, one made prior to the start of work and one completed at mid-shift. Additional trial welds will be required after repairs are made to the apparatus.
4. Cut six one-inch wide by six-inch long test strips from the trial weld.
5. Quantitatively test three specimens for peel adhesion, and then three specimens for shear strength.
6. Trial weld specimens shall pass when the results shown in Table 2.4 are achieved in both peel and shear test.

TABLE 2.4: MINIMUM WELD VALUES FOR HDPE GEOMEMBRANES

Property	Test Method	Minimum Value
Peel Strength (fusion), ppi	ASTM D 6392	98
Peel Strength (extrusion), ppi	ASTM D 6392	78
Shear Strength (fusion & ext.), ppi	ASTM D 6392	121

7. The break, when peel testing, occurs in the liner material itself, not through peel separation (Film Tear Bond (FTB) break).
8. The break is ductile.
9. A test will be considered a failure if one specimen on either peel or shear testing does not meet the requirements on Table 2.5 or does not achieve an FTB break.
10. Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear.
11. No welding equipment or welder shall be allowed to perform production welds until equipment and welders have successfully completed two additional trial welds.

F. Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. The CONTRACTOR shall demonstrate that acceptable seaming can be performed by completing acceptable trial welds. For installation integrity and safety purposes, liner seaming shall be monitored continuously and ballast shall be installed properly to keep wind from causing uplift to the liner. The CONTRACTOR shall demonstrate that safe and acceptable liner seaming can be performed without damage to the liner and liner seaming integrity shall be maintained. Liner seaming shall not proceed when wind speeds are high with wind gusts above 29 mph.

G. Defects and Repairs

1. Examine all seams and non-seam areas of the geomembrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter.
2. Repair and non-destructively test each suspect location in both seam and non-seam areas. Do not cover geomembrane at locations that have been repaired until test results with passing values are available.

3.04 FIELD QUALITY ASSURANCE

A. The manufacturer and CONTRACTOR shall participate in and conform to all terms and requirements of the OWNER'S quality assurance program. The CONTRACTOR shall be responsible for assuring this participation.

B. Quality Assurance requirements are as specified in this section.

C. Field Testing

1. Non-destructive testing shall be carried out as the seaming progresses, not at completion of all field seaming. Each seam shall be non-destructive tested.
   a. Vacuum Testing
      1) Shall be performed in all extrusion welds performed during installation and in accordance with ASTM D 5641.
      2) The vacuum box assembly shall consist of the following:
         a) Rigid housing;
         b) Transparent viewing window;
         c) Soft rubber gasket attached to bottom of housing;
         d) Porthole or valve assembly;
         e) Vacuum gauge; and
         f) A vacuum pump capable of delivering a minimum of a 27 psi vacuum.
      3) When vacuum testing, the installer shall:
         a) Carefully trim all overlapped material using an approved cutting instrument. The "pull-tear" method of overlap removal shall not be accepted;
         b) Clean windows, gasket surfaces, and check for leaks;
         c) Wet a strip of geomembrane approximately 1 foot by 2.5 feet (length of box) with soapy solution;
         d) Place the vacuum box over the wetted area;
         e) Ensure that a leak-tight seal is created;
         f) Apply a minimum vacuum pressure of five psi;

g) For a period of not less than 15 seconds, examine the length of weld through the viewing window for the presence of soap bubbles;
h) If no bubbles appear after 15 seconds, move the box over the next adjoining area with a minimum three inches of overlap and repeat the process;
i) Areas where soap bubbles appear shall be marked, repaired, and re-tested;
j) All vacuum testing will be documented by the CONTRACTOR'S QC Technician and submitted to the ENGINEER or the OWNER'S CQA ADMINISTRATOR at the end of each WORK shift. The liner shall be indelibly marked near the seam to indicate passing or failing test results accordingly.

b. Air Pressure Testing
1) Shall be performed in all hot wedge welds performed during installation and in accordance with ASTM D 5820;
2) The equipment for pressure testing shall include the following:
a) Air pumps equipped with a pressure gauge capable of generating and sustaining a pressure of 30 pounds per square inch (psi); and
b) Sharp hollow needles or other pressure feed devices approved by the ENGINEER. The liner shall be indelibly marked near the tested area to indicate passing or failing test results accordingly.
3) To perform the air pressure test, the installer's QC Technician shall:
a) Pass air through the channel to guarantee a clear pathway;
b) Seal both ends of the seam to be tested;
c) Insert a needle or other approved pressure-feed device into the tunnel created by double hot wedge seaming;
d) Energize the air pump to 30 psi;
e) Close the valve while sustaining the air pressure and allow the air to reach ambient liner temperature;
f) Read the pressure gauge;
g) Sustain the test for a minimum of five minutes and re-read the pressure gauge;
h) If the loss of pressure exceeds three psi after a two-minute period or does not stabilize, faulty areas shall be located and repaired. After testing, pressure-feed devices shall be removed and insertion points sealed; and
i) All pressure testing shall be documented by the CONTRACTOR'S QC Technician and submitted to the ENGINEER the OWNER'S CQA ADMINISTRATOR by the end of each WORK shift. The liner shall be indelibly marked near the seam to indicate passing or failing test results accordingly.

c. Alternative testing methods other than vacuum or pressure testing may be proposed by the CONTRACTOR and will be subject to the approval of the ENGINEER prior to their use.

d. Spark Testing
1) Spark Testing shall be performed accordance with ASTM D 7240 Standard Practice for Leak Location using Geomembranes with an Insulating Layer in Intimate Contact with a Conductive Layer via Electrical Capacitance Technique (Conductive Geomembrane Spark Test).

e. At locations where seams cannot be non-destructively tested, the CONTRACTOR shall:

1) Cap-strip seams with the same geomembrane when possible; and
2) If the seam is accessible to testing equipment prior to final installation, non-destructively test the seam prior to final installation.

f. Seaming and cap-stripping operations will be observed by the ENGINEER or the OWNER'S CQA ADMINISTRATOR for uniformity and completeness.

2. Destructive Testing (performed by the CONTRACTOR with observation from the ENGINEER or the OWNER'S CQA ADMINISTRATOR)

a. Location and frequency of testing

1) Collect destructive test samples at a frequency of one per every 500 lineal feet of seam length per machine used.
2) Test locations will be determined after seaming. Locations are preferred to be near the shoulder or liner run-out to the anchor trench. Multiple samples taken from the pond bottom and sump areas of the pond shall be minimal or avoided, if possible.
3) The CONTRACTOR may exercise the method of attributes as described by GRI GM-14 to minimize test samples taken with approval of the ENGINEER or the OWNER'S CQA ADMINISTRATOR.

b. Sampling Procedures are performed as follows:

1) The CONTRACTOR shall cut samples at locations designated by the ENGINEER or the OWNER'S CQA ADMINISTRATOR as seaming progresses in order to obtain field laboratory test results before the geomembrane is covered.
2) The ENGINEER or the OWNER'S CQA ADMINISTRATOR will number each sample, and the location will be noted on the installation as-built.
3) Samples shall be 12 inches wide by 40 inches long with the seam centered lengthwise (length may vary to minimize cutting of the liner).
4) Cut 10 one-inch wide by six-inch long test strips from each end of the samples for field testing.
5) The remaining sample shall be distributed as follows:
   a) One portion for CONTRACTOR, 12 by 12 inches
   b) One portion for the third party laboratory, 12 by 18 inches
   c) Additional samples may be archived if required by OWNER
6) The CONTRACTOR shall repair all holes in the geomembrane resulting from destructive sampling.
7) Repair and test the continuity of the repair in accordance with these SPECIFICATIONS.

c. Destructive testing procedures

1) Destructive testing shall be performed in accordance with ASTM D6392.
2) Quantitatively test five specimens for peel adhesion, and then five specimens for shear strength.
3) Destructive testing specimens shall pass when the results shown in Table 2.5 are achieved in both peel and shear test.
4) The break, when peel testing, shall occur in the liner material itself, not through peel separation (FTB).
5) The break is to be ductile.
6) A test will be considered a failure if one specimen on either peel or shear testing does not meet the requirements on Table 2.5 or does not achieve an FTB break.

3. Failed Seam Procedures

a. If the seam fails, the CONTRACTOR shall follow one of two options:

1) Reconstruct the seam between any two passed test locations.
2) Trace the weld to intermediate locations at least 10 feet minimum or where the seam ends in both directions from the location of the failed test. If necessary the failed seam shall be traced to previous days of seaming for the particular machine.
3) All tracing events shall be recorded by the ENGINEER or the OWNER'S CQA ADMINISTRATOR.

b. An additional sample is required for the next seam welded using the same welding device regardless of the length of the next seam.

c. If the new sample passes, then the failed seam shall be reconstructed or capped between the test sample locations.

d. If any sample fails, the process shall be repeated to establish the zone in which the seam is to be reconstructed.

3.05 REPAIR PROCEDURES

A. Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.

B. Repair any portion of unsatisfactory geomembrane or seam area failing a destructive or non-destructive test.

C. Install additional liner anywhere excessive tension (trampolines) exists.

D. The CONTRACTOR shall be responsible for repair of defective areas.

E. Agreement upon the appropriate repair method shall be decided between the ENGINEER or OWNER and CONTRACTOR by using one of the following repair methods:

1. Patching – Used to repair large holes, tears, undispersed raw materials and contamination by foreign matter. Patch materials shall be of the same material type and thickness as the material being repaired. A patch shall be a minimum of 6 inches larger in all directions than the area requiring repair. All patches shall have rounded corners;
2. Abrading and Re-welding – Used to repair short section of a seam;
3. Spot Welding – Used to repair pinholes or other minor, localized flaws, or where geomembrane thickness has been reduced;
4. Capping – Used to repair long lengths of failed seams;
5. Flap Welding – Used to extrusion-weld the flap (excess outer portion) of a fusion weld in lieu of a full cap; or
6. Remove the unacceptable seam and replace with new material.

F. The following procedures shall be observed when a repair method is used:

1. All geomembrane surfaces shall be clean and dry at the time of repair;
2. Surfaces of the geomembrane which are to be repaired by extrusion welds shall be lightly abraded to assure cleanliness; and
   Extend patches or caps at least six inches for extrusion welds and six inches for wedge welds beyond the edge of the defect, and around all corners of patch material.

G. Repair Verification

1. Number and log each patch repair (performed by the CONTRACTOR and ENGINEER or the OWNER'S CQA ADMINISTRATOR)
2. Non-destructively test each repair using methods described in this SPECIFICATION
3. Any rips, tears or damaged areas on the deployed liner shall be removed and patched. If the area to be repaired is more than 50 percent of the width of the panel, the damaged area shall be cut out, the two portions shall be cut out, and the two portions of the liner shall be joined in accordance with these SPECIFICATIONS.

3.06 DEPTH OR ELEVATION MARKINGS

A. Following completion of geomembrane installation paint depth or elevation markings as shown on the DRAWINGS.

B. Paint shall be non-corrosive and weather resistant.

END OF SECTION 33 47 13.14

SECTION 33 47 13.15 - GEOTEXTILES

PART 1 - GENERAL

1.01 SUMMARY

A. The WORK described in this SPECIFICATION section includes the manufacture and installation of geotextile fabrics as stand-alone items only and not included as part of a geocomposite.

1.02 SUBMITTALS

A. Product Data

1. The CONTRACTOR shall provide to the ENGINEER or the OWNER'S CQA ADMINISTRATOR a certificate stating the name of the manufacturer, product name, style number, chemical composition of the filaments or yarns, and other pertinent information to fully describe the geotextile. The certification shall state that the furnished geotextile meets Minimum Average Roll Value (MARV) requirements of the SPECIFICATION as evaluated under the manufacturer's quality control program. The certification shall be attested to by a person having legal authority to bind the manufacturer.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):
1. ASTM D4354 – Practice for Sampling of Geosynthetics for Testing
2. ASTM D4355 – Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
3. ASTM D4533 – Test Method for Index Trapezoid Tearing Strength of Geotextiles
4. ASTM D4632 – Test Method for Grab Breaking Load and Elongation of Geotextiles
5. ASTM D4751 – Test Method for Determining Apparent Opening Size of a Geotextile
6. ASTM D4833 – Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
7. ASTM D4873 – Guide for Identification, Storage, and Handling of Geotextiles
8. ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity
9. ASTM D5261 - Standard Test Method for Measuring Mass per Unit Area of Geotextiles

B. American Association for Laboratory Accreditation (A2LA)

C. Geosynthetic Accreditation Institute (GAI) – Laboratory Accreditation Program (LAP)

D. National Transportation Product Evaluation Program (NTPEP)

1.04 DEFINITIONS

A. Minimum Average Roll Value (MARV): Property value calculated as typical minus two standard deviations. Statistically, it yields a 97.7% degree of confidence that any sample taken during quality assurance testing will exceed value reported.

1.05 QUALIFICATIONS

MANUFACTURER shall have manufactured a minimum of 10,000,000 square feet of geotextile material during the last year.

1.06 MATERIAL LABELING, DELIVERY, STORAGE, AND HANDLING

A. Geotextiles labeling, shipment, and storage shall follow ASTM D4873. Product labels shall clearly show the manufacturer or supplier name, style name, and roll number.

B. Each geotextile roll shall be wrapped with a material that will protect the geotextile from damage due to shipment, water, sunlight, and contaminants.

C. During storage, geotextile rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames (including welding sparks), excess temperatures, and any other environmental conditions that may damage the physical properties of the geotextile.

PART 2 - PRODUCTS

2.01 GEOTEXTILE

A. The geotextile shall be manufactured with fibers consisting of long-chain synthetic polymers composed of at least 95% by weight of polyfins or polyesters. They shall form a stable network such that the filaments or yarns retain their dimensional stability relative to each other, including selvages.

B. Woven slit film geotextiles (i.e., geotextiles made from yarns of a flat, tape-like character) shall not be allowed.

C. The geotextile shall meet the requirements of Tables 2.1 and 2.2. All numeric values in Table 2.1 and Table 2.2 except Apparent Opening Size (AOS) represent MARV in the weakest principal direction. Values for AOS represent maximum average roll values.

TABLE 2.1: 10 OZ GEOTEXTILE REQUIREMENTS

Property	Test Method	Units	Value
Mass per unit Area	ASTM D5261	oz/yd^2	10
Grab Tensile Strength	ASTM D4632	lbs	270
Grab Tensile Elongation	ASTM D4632	%	50
Trapezoid Tear Strength	ASTM D4533	lbs	105
CBR Puncture Strength	ASTM D4833	lbs	725
Permittivity	ASTM D4491	sec^{-1}	1.0
Apparent Opening Size	ASTM D4751	U.S. Sieve	100
Water Flow Rate	ASTM D4491	gpm/ft^2	75
UV Resistance[1]	ASTM D4355	%	70

[1]After 500 hrs

TABLE 2.2: 8 OZ GEOTEXTILE REQUIREMENTS

Property	Test Method	Units	Value
Mass per unit Area	ASTM D5261	oz/yd^2	8
Grab Tensile Strength	ASTM D4632	lbs	220
Grab Tensile Elongation	ASTM D4632	%	50
Trapezoid Tear Strength	ASTM D4533	lbs	95
CBR Puncture Strength	ASTM D4833	lbs	575
Permittivity	ASTM D4491	sec^{-1}	1.3
Apparent Opening Size	ASTM D4751	U.S. Sieve	80
Water Flow Rate	ASTM D4491	gpm/ft^2	95
UV Resistance[1]	ASTM D4355	%	70

2.02 QUALITY CONTROL

A. Manufacturing Quality Control: Testing shall be performed at a laboratory accredited by GAI-LAP and A2LA for tests required for the geotextile, at a frequency meeting or exceeding ASTM D4354.

B. Geotextile properties, other than sewn seam strength, burst strength, and ultraviolet stability shall be tested by NTPEP to verify conformance with this SPECIFICATION.

C. Sewn seam strength shall be verified based on testing of either conformance samples obtained using Procedure A of ASTM D4354, or based on manufacturer's certifications and testing of quality assurance samples obtained using Procedure B of ASTM D4354. A lot size for conformance or quality assurance sampling shall be considered to be the shipment quantity of the given product or a truckload of the given product, whichever is smaller.

D. Ultraviolet stability shall be verified by an independent laboratory on the geotextile or a geotextile of similar construction and yarn type.

PART 3 - EXECUTION

3.01 PREPARATION

A. Grading shall be done in such a way so as to prevent large voids from occurring along the geotextile contact. The graded surface shall be smooth and free of debris.

3.02 INSTALLATION

A. The geotextile installation shall meet the manufacturer's recommendations for preparation, storage and placement or installation.

B. The geotextile shall be placed loosely with no wrinkles or folds, and with no void spaces between the geotextile and the ground surface and heat bonded, sewn, or otherwise secured to avoid damage and maintenance of the overlap. Successive sheets of geotextiles shall be overlapped a minimum of 12 inches, with the upstream sheet overlapping the downstream sheet.

C. Should the geotextile be damaged during installation or drainage aggregate placement, a geotextile patch shall be placed over the damaged area extending beyond the damaged area a distance of 6 inches, or the specified seam overlap, whichever is greater.

END OF SECTION 33 47 13.15

SECTION 40 23 00 - POLYETHYLENE PIPE

PART 4 - GENERAL

4.01 SUMMARY

A. The WORK of this SPECIFICATION section shall consist of furnishing and installing the conveyance piping and appurtenances associated with the sump and collection trench as shown on the DRAWINGS. Piping materials for the intake and discharge piping into the pond collection sump, as shown, is supplied by others.

B. The CONTRACTOR shall furnish all labor, materials, tools, equipment, and services for construction of the polyethylene piping and appurtenances.

C. Although such WORK may not be specifically indicated, CONTRACTOR shall furnish and install all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a fully functional installation.

4.02 PIPEWORK AND APPURTENANCES

A. All drainage, collection and conveyance pipework shall be carefully fabricated and placed as shown on the DRAWINGS and approved by the OWNER.

B. All pipe invert elevations and gradients shall be accurately set. CONTRACTOR shall adequately anchor or ballast the pipe to prevent movement during construction.

4.03 REFERENCES

A. Provide IPS size HDPE pipe in accordance with the following standards and all other mandatory ASTM requirements detailed therein.

1. American Society for Testing and Materials (ASTM) most current versions and other applicable standards.
   a. ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
   b. ASTM F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter

4.04 SUBMITTALS

A. The CONTRACTOR shall submit the following:

1. Shop drawings of HDPE pipe, fittings, and manner of securing; a list of materials to be furnished; and the name of the pipe manufacturer;
2. Product data sheets showing compliance with the product requirements of this Section

3. Certifications of welder's qualifications for HDPE pipe fusion required for the project.

B. Submit manufacturer's installation instructions and maintain a copy on-site for reference during construction.

4.05 PIPE WELDERS QUALIFICATIONS

A. All operators conducting fusion welding activities must be certified by the manufacturer as technically qualified and properly experienced for fusion welding of HDPE pipe.

B. Submit names of certified operators in accordance with this Section.

PART 5 - PRODUCTS

5.01 HDPE PIPE

A. HDPE pipe and fittings shall be high-density, high molecular weight polyethylene pipe PE 4710.

B. High density polyethylene (HDPE) resin: compounded and manufactured specifically for producing HDPE pipe.

C. Pipe: Manufactured in accordance with ASTM D3350 and ASTM F 714.

D. Dimension Ratio (DR): As required by the DRAWINGS.

E. HDPE pipes shall be supplied in standard laying lengths not exceeding 40 feet.

F. HDPE pipes and fittings shall be homogeneous throughout and free of visible cracks, holes (other than manufactured perforations per design), foreign inclusions, or other deleterious effects, and shall be uniform in color, density, melt index, and other physical properties.

G. Fitting at the toe of the slope for the LDS pipe shall consist of a fabricated bend constructed of the same material as the pipe. The deflection angle of the bend shall match the slope.

H. At the LCS sump the annular space between the inner and outer pipes shall be completely and permanently sealed against leakage.

PART 6 - EXECUTION

6.01 GENERAL

A. Coordinate details of the prefabricated pipe penetration through the primary liner with the liner manufacturer and CONTRACTOR.

6.02 HANDLING AND PLACEMENT

A. HDPE pipe and fittings shall be installed as indicated on the DRAWINGS.

B. The CONTRACTOR shall exercise care when transporting, handling and placing pipe and fittings, such that they will not be cut, kinked, twisted, or otherwise damaged.

C. The CONTRACTOR shall comply with the pipe manufacturer's recommendations for handling, storage, and installation of all polyethylene pipe and fittings.

D. Ropes, fabric, or rubber-protected slings and/or straps shall be used when handling pipe. Chains, cables or hooks shall not be used as a means of handling pipe.

E. Pipe or fittings shall not be dropped or dragged over sharp objects.

F. The maximum allowable depth of cuts, gouges, or scratches on the exterior surface of pipe or fittings is 10% of the wall thickness. The interior of the pipe and fittings shall be free of cuts, gouges, and scratches. CONTRACTOR shall be required to remove and replace damaged pipe, at no additional cost to the OWNER.

G. Whenever pipe laying is not actively in progress, the open ends of pipes that have been placed shall be closed using watertight plugs.

6.03 INSTALLATION

A. Pipe shall be laid on geocomposite or geotextile or rub sheets as shown on the DRAWINGS outside of the pond cell.

B. All polyethylene pipe and fittings shall be installed in accordance with this SPECIFICATION and in conformance with the pipe manufacturer's written instructions.

C. The CONTRACTOR shall carefully examine all pipe and fittings for cracks, damage, or defects before installation.

D. The interiors of all pipes and fittings shall be inspected, and foreign materials shall be completely removed from the pipe and fitting interiors before they are moved into their final positions.

E. Do not damage underlying WORK, soil layers or geosynthetic installations during pipe installation operations. Repair all damaged WORK.

6.04 JOINTS AND CONNECTIONS

A. Fusion joining equipment shall be as supplied by, leased from, or approved by the pipe manufacturer.

B. Joining techniques and operating procedures shall carefully follow written instructions provided by the pipe manufacturer and the joint equipment supplier. A copy of such instructions, including heating time, cooling time, fusion temperature, and fusion pressure for each size of pipe shall be present at any location in which butt-fusion is being carried out.

C. Fusion Joining Requirements:

1. All HDPE pipe shall be joined to itself by the heat fusion process which produces homogeneous, seal, leak tight joints. Tie-ins between sections of HDPE pipe shall be made by butt fusion whenever possible.

2. Butt Fusion: The pipe shall be joined by the butt fusion procedure outlined in ASTM F 2620 or PPI TR-33. All fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations. Fusion joints shall be made by qualified fusion technicians per PPI TN-42. A record or certificate of training for the fusion operator must be provided that documents training to the fundamentals of ASTM F 2620. Considerations should be given to and provisions made for adverse weather conditions, such as temperatures below freezing, precipitation, or wind, which is accepted by the owner/engineer.

6.05 PERFORATIONS

A. Perforations as shown on the DRAWINGS may be manufactured or field constructed with approval from the ENGINEER or OWNER.

END OF SECTION 40 23 00

Appendix 6 – HDPE Liner Specifications

19103 Gundle Road
Houston, TX 77073
800 435 2008 • 281 443 8564
281 230 8650 Fax
www.gseworld.com

October 27, 2016

Tony Banuelos
EC Applications-Texas
12002 E Highway 158
Gardendale, TX 79758

RE: GSE Geomembrane – Permeability for EDS-040NE and EDS-060NE

Certification of Compliance

The undersigned, being qualified and authorized to do so, hereby certifies that GSE 40 mil and 60 EDS Geomembrane will meet a permeability of $< 1 \times 10^{-12}$ cm/s when tested per ASTM E96.

Sincerely,

Miguel Garcia
GSE Technical Support

MG16-0214

PRODUCT DATA SHEET

GSE HD Smooth Geomembrane

GSE HD is a smooth high density polyethylene (HDPE) geomembrane manufactured with the highest quality resin specifically formulated for flexible geomembranes. This product is used in applications that require excellent chemical resistance and endurance properties.

AT THE CORE:

An HDPE geomembrane used in applications that require excellent chemical resistance and endurance properties.

Product Specifications

These product specifications meet GRI GM 13

Tested Property	Test Method	Frequency	Minimum Average Value				
			30 mil	40 mil	60 mil	80 mil	100 mil
Thickness, mil Lowest individual reading	ASTM D 5199	every roll	30 27	40 36	60 54	80 72	100 90
Density, g/cm³	ASTM D 1505	200,000 lb	0.940	0.940	0.940	0.940	0.94
Tensile Properties (each direction) Strength at Break, lb/in-width Strength at Yield, lb/in-width Elongation at Break, % Elongation at Yield, %	ASTM D 6693, Type IV Dumbbell, 2 ipm G.L. 2.0 in G.L. 1.3 in	20,000 lb	 114 63 700 12	 152 84 700 12	 228 126 700 12	 304 168 700 12	 380 210 700 12
Tear Resistance, lb	ASTM D 1004	45,000 lb	21	28	42	56	70
Puncture Resistance, lb	ASTM D 4833	45,000 lb	54	72	108	144	180
Carbon Black Content, % (Range)	ASTM D 1603*/4218	20,000 lb	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note(1)	Note(1)	Note(1)	Note(1)	Note(1)
Notched Constant Tensile Load, hr	ASTM D 5397, Appendix	200,000 lb	500	500	500	500	500
Oxidative Induction Time, mins	ASTM D 3895, 200°C; O_2 1 atm	200,000 lb	>100	>100	>100	>100	>100
TYPICAL ROLL DIMENSIONS							
Roll Length(2), ft			1,120	870	560	430	340
Roll Width(2), ft			22.5	22.5	22.5	22.5	22.5
Roll Area, ft²			25,200	19,575	12,600	9,675	7,650

NOTES:
- (1)Dispersion only applies to mear spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- (2)Roll lengths and widths have a tolerance of ±1%.
- GSE HD is available in rolls weighing approximately 3,900 lb.
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LTB of <-77°C when tested according to ASTM D 746.
- *Modified.

GSE is a leading manufacturer and marketer of geosynthetic lining products and services. We've built a reputation of reliability through our dedication to providing consistency of product, price and protection to our global customers.

Our commitment to innovation, our focus on quality and our industry expertise allow us the flexibility to collaborate with our clients to develop a custom, purpose-fit solution.

GSE ENVIRONMENTAL™

DURABILITY RUNS DEEP

For more information on this product and others, please visit us at GSEworld.com, call 800.435.2008 or contact your local sales ofice.

Venegas, Victoria, EMNRD

From: Venegas, Victoria, EMNRD
Sent: Tuesday, March 14, 2023 11:36 AM
To: Vallejo, Tony
Subject: •1RF-503 - COTTON DRAW SECTION 9 RECYCLING CONTAINMENT FACILITY ID [fVV2307337448]
Attachments: C-147 1RF-503 - COTTON DRAW SECTION 9 RECYCLING CONTAINMENT FACILITY ID [fVV2307337448].pdf

1RF-503 - COTTON DRAW SECTION 9 RECYCLING CONTAINMENT FACILITY ID [fVV2307337448]

Good morning Mr. Vallejo,
NMOCD has reviewed the recycling containment permit application and related documents, submitted by [4323] CHEVRON USA INC on February 28, 2023, for 1RF-503 - COTTON DRAW SECTION 9 RECYCLING CONTAINMENT FACILITY ID [fVV2307337448] in Unit Letter A, Section 09, Township 25S, Range 32E, Lea County, New Mexico. [4323] CHEVRON USA INC requested variances from 19.15.34 NMAC for 1RF-503 - COTTON DRAW SECTION 9 RECYCLING CONTAINMENT FACILITY ID [fVV2307337448].

The following variances have been approved:

- The variance to 19.15.34.12.A.(4) NMAC for the installation on the containment of a 60 mil HDPE as secondary liner is approved. The 60 mil HDPE exhibits a maximum hydraulic conductivity of 1×10^{-12} cm/sec, which exceeds the specified performance of 1×10^{-9} cm/sec.
- The variance from 19.15.34.13.D NMAC, for the installation of an eight-foot-tall chain link fence equipped with three strands of barbed wire on top, is approved.
- The variance from 19.15.34.13.E NMAC for the installation of an audible bird deterrence system, “Bird-X Mega-Blaster Pro”, is approved.

The form C-147 and related documents for 1RF-503 - COTTON DRAW SECTION 9 RECYCLING CONTAINMENT FACILITY ID [fVV2307337448] is approved with the following conditions of approval:

- The purpose of this permit is for oil and gas activities regulated under the NMAC 19.15.34.3 STATUTORY AUTHORITY: 19.15.34 NMAC is adopted pursuant to the Oil and Gas Act, Paragraph (15) of Section 70-2-12(B) NMSA 1978, which authorizes the division to regulate the disposition of water produced or used in connection with the drilling for or producing of oil and gas or both and Paragraph (21) of Section 70-2-12(B) NMSA 1978 which authorizes the regulation of the disposition of nondomestic wastes from the exploration, development, production or storage of crude oil or natural gas.
- [4323] CHEVRON USA INC shall construct, operate, maintain, close, and reclaim 1RF-503 - COTTON DRAW SECTION 9 RECYCLING CONTAINMENT FACILITY ID [fVV2307337448] in compliance with NMAC 19.15.34 NMAC.
- 1RF-503 - COTTON DRAW SECTION 9 RECYCLING CONTAINMENT FACILITY ID [fVV2307337448] is approved for five years of operation from the date of permit application.
- 1RF-503 - COTTON DRAW SECTION 9 RECYCLING CONTAINMENT FACILITY ID [fVV2307337448] permit expires on February 28, 2028. If [4323] CHEVRON USA INC wishes to extend operations past five years, an annual permit extension request must be submitted using an OCD form C-147 through OCD Permitting by January 28, 2028.
- [4323] CHEVRON USA INC shall notify OCD, through OCD Permitting, when construction of 1RF-503 - COTTON DRAW SECTION 9 RECYCLING CONTAINMENT FACILITY ID [fVV2307337448] commences.
- [4323] CHEVRON USA INC shall notify NMOCD through OCD Permitting when recycling operations commence and cease at 1RF-503 - COTTON DRAW SECTION 9 RECYCLING CONTAINMENT FACILITY ID [fVV2307337448].
- A minimum of 3-feet freeboard must be maintained at 1RF-503 - COTTON DRAW SECTION 9 RECYCLING CONTAINMENT FACILITY ID [fVV2307337448] at all times during operations.

- If less than 20% of the total fluid capacity is utilized every six months, beginning from the first withdrawal, operations of the 1RF-503 - COTTON DRAW SECTION 9 RECYCLING CONTAINMENT FACILITY ID [fVV2307337448] is considered ceased and a notification of cessation of operations should be sent electronically to OCD Permitting. A request to extend the cessation of operation, not to exceed six months, may be submitted using a C-147 form through OCD Permitting.
- If after that 6-month extension period, the 1RF-503 - COTTON DRAW SECTION 9 RECYCLING CONTAINMENT FACILITY ID [fVV2307337448] is not utilized at a minimum of 20% fluid capacity, no additional extensions would be granted, and the operator would be directed to remove all fluids and proceed with the closure requirements.
- [4323] CHEVRON USA INC shall submit monthly reports of recycling and reuse of produced water, drilling fluids, and liquid oil field waste on OCD form C-148 via OCD Permitting even if there is zero activity.
- [4323] CHEVRON USA INC shall inspect the recycling containment and associated leak detection systems weekly while it contains fluids. The operator shall maintain a current log of such inspections and make the log available for review by the division upon request as per 19.15.34.13.A.
- [4323] CHEVRON USA INC shall comply with 19.15.29 NMAC Releases in the event of any release of produced water or other oil field waste at 1RF-503 - COTTON DRAW SECTION 9 RECYCLING CONTAINMENT FACILITY ID [fVV2307337448].

Please reference number 1RF-503 - COTTON DRAW SECTION 9 RECYCLING CONTAINMENT FACILITY ID [fVV2307337448] in all future communications.
Regards,

Victoria Venegas ● Environmental Specialist
Environmental Bureau
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State of New Mexico
Energy, Minerals and Natural Resources
Oil Conservation Division
1220 S. St Francis Dr.
Santa Fe, NM 87505

CONDITIONS

Action 191367

CONDITIONS

Operator: CHEVRON U S A INC 6301 Deauville Blvd Midland, TX 79706	OGRID: 4323
	Action Number: 191367
	Action Type: [C-147] Water Recycle Long (C-147L)

CONDITIONS

Created By	Condition	Condition Date
vvenegas	NMOCD has reviewed and approved the recycling containment permit application and related documents, submitted by [4323] CHEVRON USA INC on February 28, 2023, for 1RF-503 - COTTON DRAW SECTION 9 RECYCLING CONTAINMENT FACILITY ID [fVV2307337448] in Unit Letter A, Section 09, Township 25S, Range 32E, Lea County, New Mexico.	3/14/2023